Newport Research Facility

ANNUAL REPORT

No. 53

Report for the year ended 31st December 2008

This report follows in sequence from the Annual Reports of the Salmon Research Agency of Ireland Inc. and The Salmon Research Trust of Ireland Inc.

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SUMMARY

1. The Salmon Research Agency of Ireland merged with the Marine Institute on the 1st July 1999 into Aquaculture & Catchment Management Services. This report provides a continuation of the data records for the Burrishoole facilities.

2. The total rainfall recorded in Furnace in 2008 was 1805.0 mm. Months of relatively high rainfall in 2008 were January, March, August and October with low rainfall in April, May, June and July.

3. The total release of microtagged salmon smolts of Burrishoole reared origin into L. Furnace amounted to 29,115. Smolts were released as three core and two SLICE treated groups, ranging in mean weight from 73g to 89g.

4. In 2007, the Irish Government introduced a cessation of drift netting for salmon at sea and this was continued in 2008.

5. A total of 548 wild grilse were recorded moving upstream through the permanent traps during the season. The number of spring fish recorded was 23. The total run of wild grilse, including the Furnace rod catch (1), was 549.

6. Returning adults were checked for net mark damage; 2.3% (n=430) of wild grilse and 1.2% (n=1165) of reared grilse had net marks recorded.

7. The maximum spawning escapement was 473 wild and 17 reared fish.

8. A total of 6909 wild salmon smolts were recorded in the downstream trap in 2008. The wild return of 2007 smolts as wild grilse in 2008 was 8.4%. The return to freshwater of the Burrishoole reared grilse recorded was 6.3%, increased from 4.8% in 2007. The ova to smolt survival at 0.53 – 0.60%

9. A total of 40 wild sea trout and a further 76 non-silvered trout migrated upstream through the traps in 2008. Of the sea trout, 11 were adults and 29 (73%) were finnock. The 2008 sea trout smolt run amounted to 393 smolts.

10. The percentage of smolts returning as finnock in the same year has historically ranged from 11.4% to 32.4%. In 1989 it collapsed to a minimum of 1.5%. There has been a saw-tooth pattern of finnock return in the 1990's between 4 & 10%, rising to 16.7% in 1999 – the highest return rate since 1986. Finnock return in 2008 was at 7.4%.

11. Silver eel trapping continued with the total run amounting to 2252 with the run mainly in September and October.

12. A total of 168 salmon were caught in the Fishery in 2008. The catch consisted of 52 wild fish and 116 reared salmon. Of the 52 wild fish caught, 51 were returned alive to the water and one was killed. There was a minimum of 21 sea trout caught on L. Furnace and three on L. Feeagh and these were returned alive. 761 brown trout were also caught on l. Feeagh in 2008.

13. Invertebrate surveys were carried out in 2008 on the Owengarve and Burrishoole catchments.

1. INTRODUCTION

The Salmon Research Agency merged with the national Marine Institute on the 1st July 1999. The staff of the Agency were absorbed into the Aquaculture and Catchment Services group of the Institute and the research facilities at Furnace have undergone a programme of upgrading and improvement. The core monitoring work of the Agency will continue but its unique experimental facilities, both in relation to aquaculture and wild fisheries, will be fully utilised within the context of the Institutes published Research, Technology, Development and Innovation Strategy. The merger has resulted in an increased national role for the work of the Agency and a consolidation of the trap and laboratory facilities at Newport.

This report represents a continuation of the Annual Reports published by the Salmon Research Agency of Ireland. The data presented creates a unique record of fish rearing and wild fish census data for the past 39 years. This data is an essential component in the local, regional and national management of salmon, sea trout and eel and is becoming ever more valuable in the light of increasing pressures on natural stocks, such as exploitation, habitat degradation and global climate change scenarios. The fish monitoring facilities in Newport, along with the reared and ranched salmon stocks held in Burrishoole, are also essential for the evaluation of novel enhancement techniques, alternative stocks and ranching and evaluation of interactions between farmed, ranched and wild strains.

Photo: M. O'Grady

2 ENVIRONMENTAL DATA

2.1 Mill Race Data

Daily meteorological data were collected during 2008 at the manual Met Station in Furnace. The monthly rainfall figures for 2005, 2006, 2007 & 2008 are given in Table 2.1, along with the annual totals for the years 1977 to 2008. Months of relatively high rainfall in 2008 were January, March, August and October. Low rainfall was recorded in April, May, June and July. The total rainfall was 1805.0 mm in 2008, the second highest this decade.

Table 2.1. Monthly rainfall totals (mm) for the Furnace Station in 2005, 2006, 2007 and 2008 and the annual totals for 1977 to 2008.

Month	2005	2006	2007	2008	Year	Total
January	286.2	95.9	202.9	227.0	1977	1579.7
February	104.5	99.7	116.6	137.5	1978	1592.2
March	76.8	131.0	122.0	230.2	1979	1653.3
April	124.8	104.5	55.7	67.6	1980	1792.1
May	140.0	135.6	129.7	29.1	1981	1646.8
June	97.1	37.8	121.1	95.8	1982	1609.6
July	44.0	60.9	191.7	62.0	1983	1495.9
August	132.2	69.0	87.4	218.9	1984	1556.6
September	123.6	198.8	120.4	178.9	1985	1584.1
October	133.9	178.0	92.0	249.4	1986	1886.9
November	182.3	182.3	131.8	179.3	1987	1373.6
December	162.8	257.3	205.5	129.3	1988	1715.2
					1989	1583.9
					1990	1805.9
					1991	1549.6
					1992	1771.1
					1993	1473.4
					1994	1757.1
					1995	1382.5
					1996	1286.6
					1997	1351.6
					1998	1830.9
					1999	1949.1
					2000	1833.2
					2001	1298.7
					2002	1715.9
					2003	1353.2
					2004	1641.3
					2005	1608.2
					2006	1550.7
					2007	1576.8
					2008	1805.0

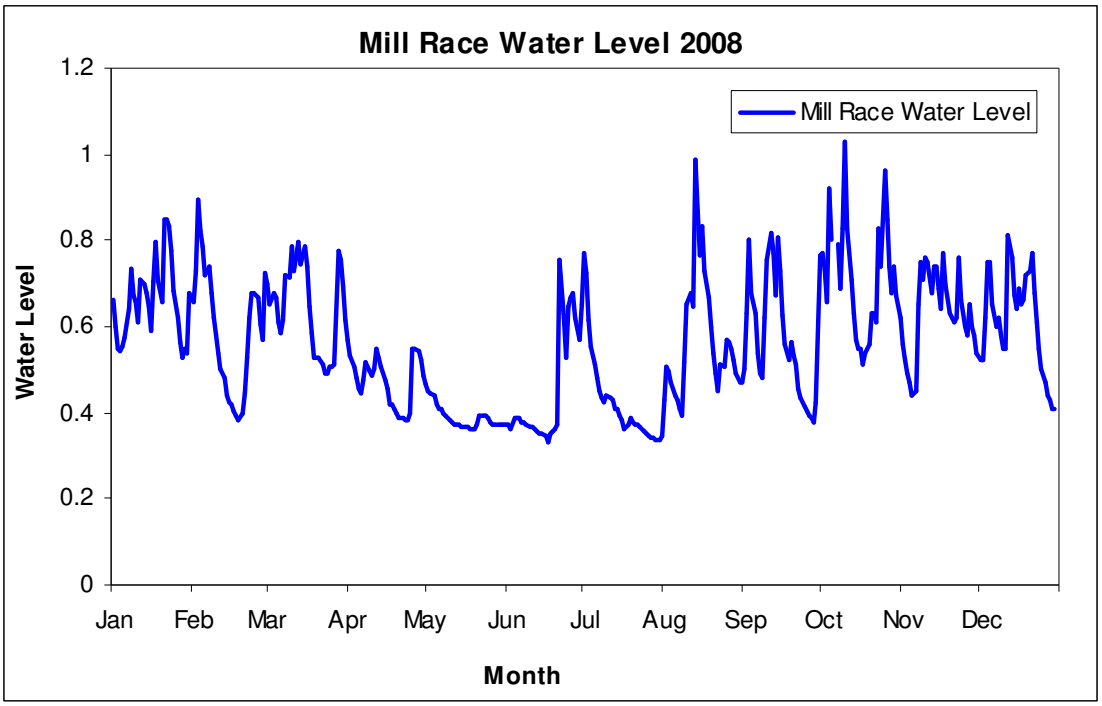


Fig. 2.1. Water levels recorded at mid-night for the Mill Race using an OTT Orphimedes automatic water level recorder.

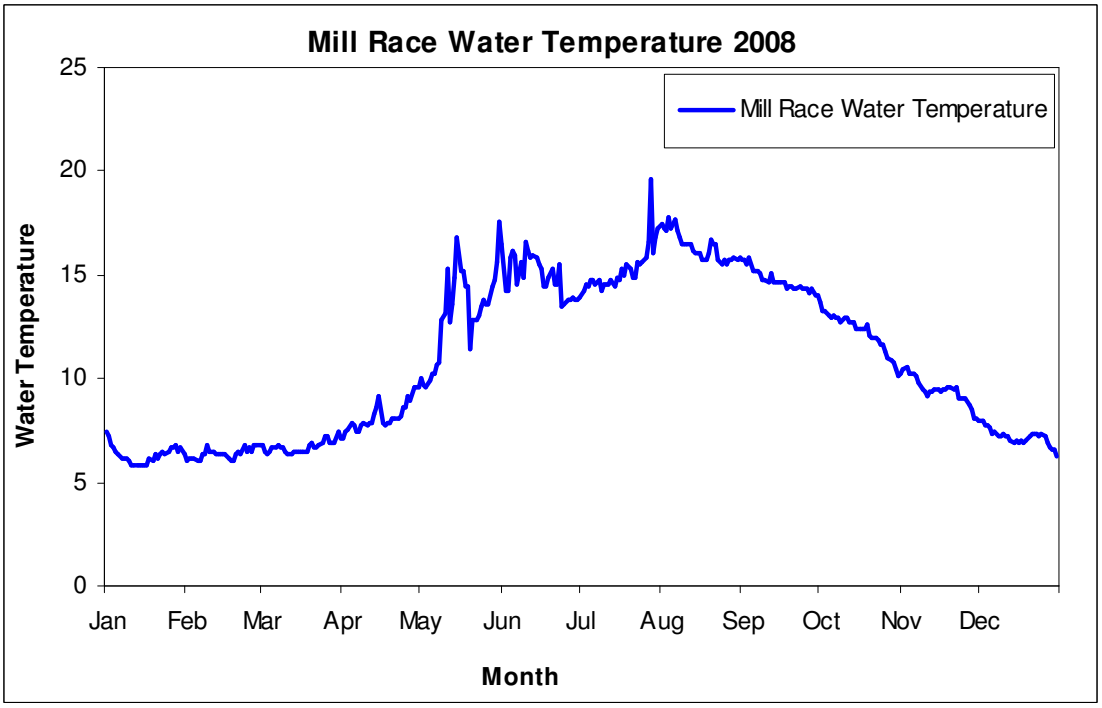


Fig. 2.2. Water temperatures recorded, by TidbiT data logger at mid-night for the Mill Race.

Water Level: Difficulties were experienced in 2003 with the automatic water level chart recorder. An OTT Orphimedes automatic water level recorder was installed in late January 2004. Water levels are recorded every 15 minutes and are presented in Figure 2.1 recorded at 23.45 hrs. This approximates to the previous mid-night readings from the chart recorder.

Water Temperature: In 2004, a TidbiT temperature logger was installed along with the chart recorder and this records water temperature every 30 minutes. The temperature logger data is presented in Figure 2.2, recorded at the closest time to midnight (<30mins).

Water temperatures (recorded at midnight) fell to a minimum of 5.9^{o}C on the 15th January. There was a steady increase in temperature from early March through to early May. Two peaks occurred in May, with maxima of 16.8^{o}C on the 15th May and 17.6^{o}C on the 31st May. A further peak of 19.6 ^{o}C occurred on the 28th July. The temperature dropped steadily from the end of July for the rest of the year to a minimum of 6.2 ^{o}C in late December.

2.2 Catchment Programme

In recent years, the combined effect of extreme weather events with impacts of land use, have had a significant effect on the erosion rates recorded in many upland areas. Since 1995 the Marine Institute has operated a series of automatic monitoring stations to monitor these impacts, and to attempt to quantify the transport of suspended sediments in the Burrishoole catchment. These automatic stations, funded under EU LIFE and National programmes, include a lake station (AWQMS – installed under EU LIFE 93), which has various meteorological instruments included with a suite of underwater temperature and water chemistry sensors, and three river stations, (ARMS – installed under EU LIFE 98), which are equipped with sensors for measuring water temperature, water level, pH, conductivity, dissolved oxygen, and turbidity. The automatic monitoring stations are also equipped with a telemetry system for relaying high-resolution data back to the laboratory.

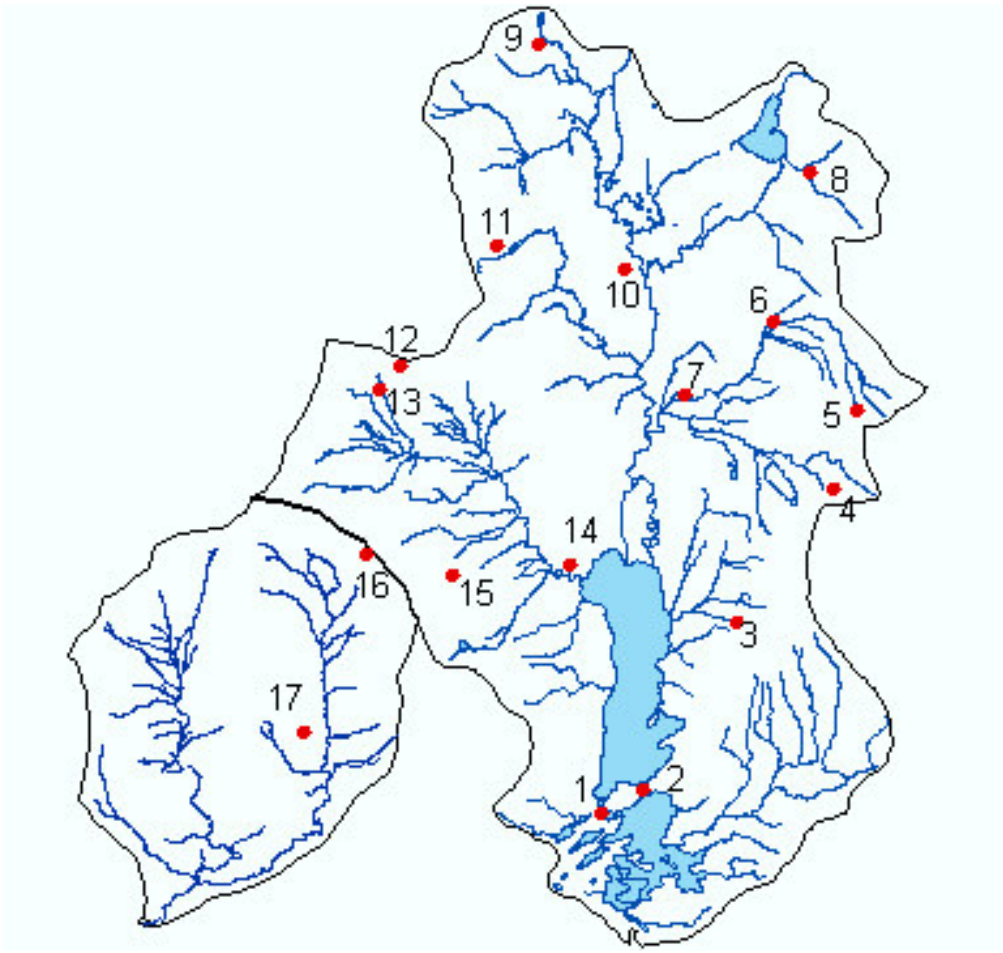
In 2008, ERDF funding was received to install an AWQMS station on Lough Furnace. The equipment was placed on a 2m diameter buoy (max height of windvane above water ~2.25m), moored in the deepest part of the lake (N53 55.094 W9 34.280). The station consists of a mini wind vane and solar sensor and underwater monitoring equipment mounted on a profiling winch, powered by a solar panel. The station measures underwater temperature, oxygen, salinity, pH, chlorophyll and turbidity. This AWQMS has a Datasonde DX5 attached to a profiling winch, enabling temperature, conductivity, dissolved oxygen (% and mg/l), salinity and pH profiles of the lake to be taken. The winch profiles the lake 4 times a day (6am, noon, 6pm and midnight), taking four hours to run a profile and is parked for two hours. There is also a nephlometer and fluorometer positioned one meter below the water column.

In addition the Institute has also deployed additional core-funded instrumentation in the catchment including temperature loggers, water level recorders and seventeen data-logging rain gauges in the Burrishoole and Owengarve catchments (Figure 2.3) and two in the Owenduff catchment, which will assist in building up a detailed profile of precipitation in a mountainous catchment.

Also deployed within the catchment are a series of OTT Orphimedes water level recorders which measure water level at fifteen-minute intervals. These data can be used to calculate water volumes on an hourly or daily basis. An important feature of the monitoring network is the ability to simultaneously collect data from river, lake, and climatic instruments. The

continuing integration of this data with ongoing fish population surveys is an important component of the research programme.

It is proposed to include the Burrishoole catchment and weather datasets in a comprehensive project funded within the SSTI Climate Change programme. This project, called RESCALE, commenced in 2008 and will report at the end of 2009.



1.	Salmon Leap	10.	Altahoney	19.	Glenadeegan
2.	Mill Race	11.	Maumaratta		
3.	Buckogh	12.	Glenamong 1		
4.	Lodge	13.	Glenamong 2		
5.	Srahrevagh 1	14.	Glenamong 3		
6.	Srahrevagh 2	15.	Glenamong 4		
7.	Srahrevagh 3	16.	Ridge		
8.	Gaulaun	17.	Glendahurk		
9.	Namaroon	18.	Tarsaghaun		

Figure 2.3. Rain gauge sites in the Burrishoole and Owengarve systems. 18 & 19 not on map.

3 SALMONID REARING

3.1 Salmon Stocks 2007

3.1.1 Ranching

The total release of microtagged smolts of ranched Burrishoole grilse origin into Lough Furnace was 29,115. Three core and two 'SLICE' groups, comprising 5 tag codes, were released on 29th April and 6th May 2008. Mean weights ranged from 73 to 89 grams.

Ongoing experimental programmes included the use of 'SLICE', to protect smolts against lice infestation during the first weeks at sea and thereby examine if lice infestations are a significant factor in early marine mortality of Irish salmon smolts.

Two groups of microtagged and vaccinated (Norvac Compact 4) pre-smolts of ranched Burrishoole grilse origin were released into the River Liffey on 27th March 2008. A total 11,071 pre-smolts, averaging 62 grams and comprising 2 tag codes, were released upstream and downstream of the ESB dam, with a view to monitoring marine survival.

Tag code details are shown in Section 5.4.

3.2 Salmon Stocks 2008

Burrishoole ranch, Delphi (2SW) ranch and commercial Aquagen (2SW) stocks were hatched in 2008.

Eyed salmon ova (108,000) of Aquagen stock were supplied on January 4th 08 for contract rearing and also to assess the freshwater performance of this newly imported Norwegian strain. In contrast to the Burrishoole stock, where survival to July was exceptionally good at 92.3%, higher losses were sustained in the Aquagen stock during May giving rise to a lower survival of 74.3% (Figure 3.1). Delivery of the Aquagen stock in early January (some four weeks earlier than requested) resulted in the fry being ready for first feeding when water temperatures were sub-optimal at 7 degrees. Fry were therefore slow to start feeding, resulting in a higher proportion of non-feeders and consequent losses in May. Thereafter losses were minimal in both stocks.

Growth rate was higher in the commercial Aquagen stock, as shown for graded fish in Figure 3.2.

Eyed ova (11,000) from 2SW Delphi ranch parents were transferred from Delphi Hatchery on 8th February 08 and a replicate batch retained for on-growing in Delphi. Salmon smolts will be ranched from both sites in 2009, to assess the return rate and run timing of adult returns.

Stocks remaining in December 2008 comprised 38,826 Burrishoole ranch, 10,768 Delphi and 75,637 Aquagen stock.

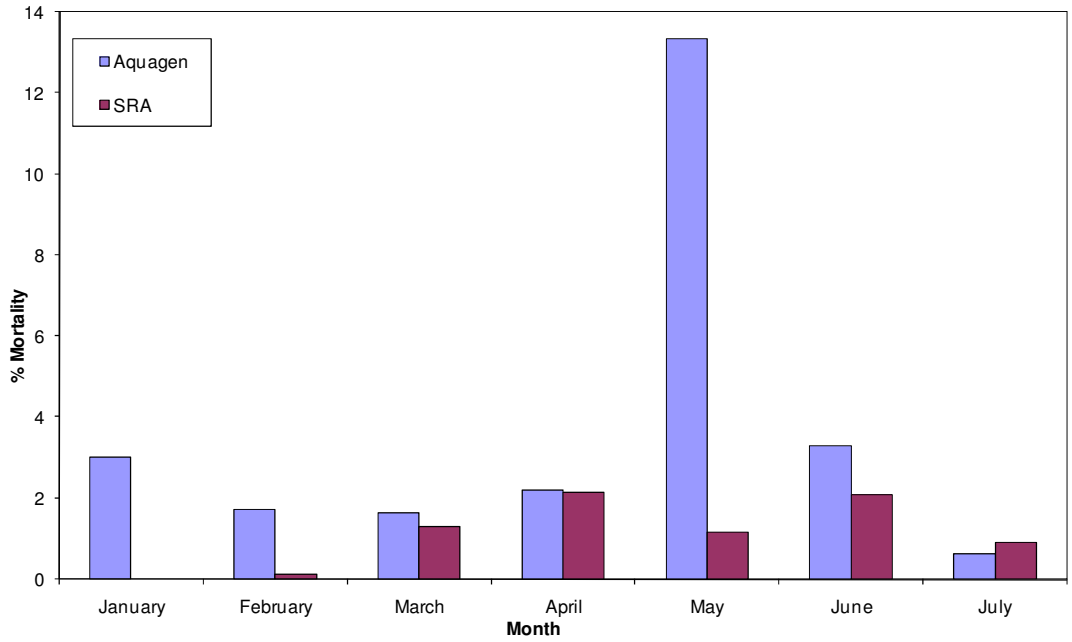


Figure 3.1. Mortality (%) in Aquagen and Burrishoole stocks January to July 2008

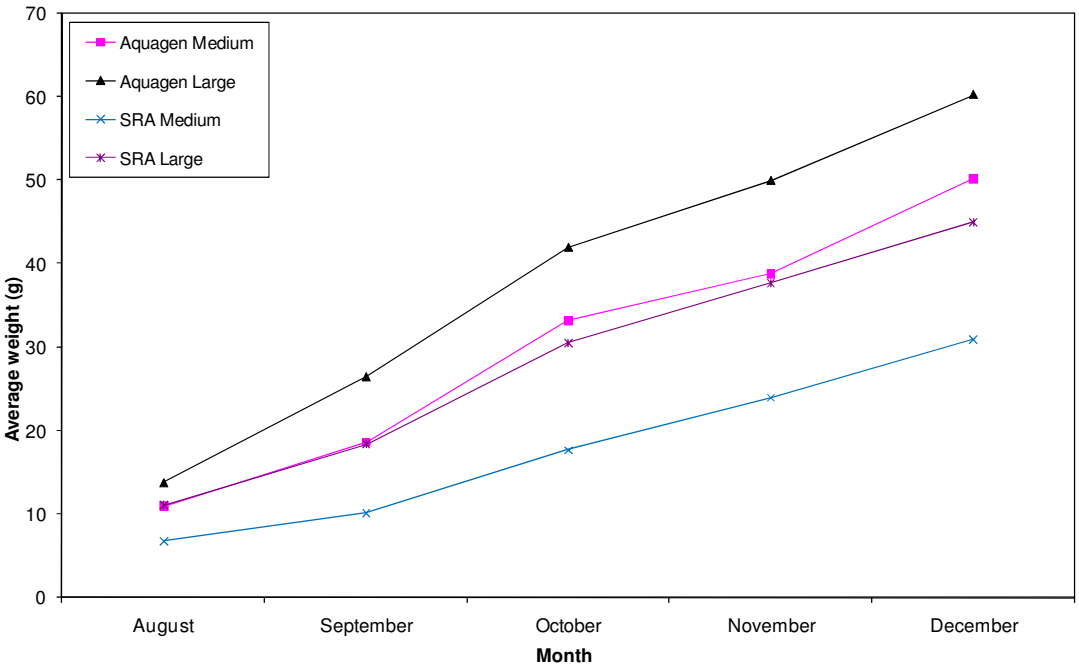


Figure 3.2. Average weights (g) of Aquagen and Burrishoole stocks August to December 2008.

3.3 Salmon Stocks 2009 (Grilse ova laid down in 2008)

An estimated 60% of all returns were processed during August, when rainfall was high, and consequently broodstock collection commenced earlier than usual. Salmon broodstock were held in a turmec cage in Lough Furnace from August 22nd and 244 salmon were transferred to the broodstock holding pond on 25th September 2008. Fortunately an independent water supply line to the broodstock pond had been installed in 2007, which facilitated this early transfer to the holding pond. Broodstock collection continued into December and in total, 385 ranch adults (199 females, 186 males) were held during the stripping period. In addition, 35 wild Burrishoole salmon (16 females, 19 males) were collected and held in the broodstock pond; 33 from the catchment and 2 from the Salmon Leap downstream trap.

As in 2007, commencement of stripping was late. On December 8th, only three hens were ready and milt production and quality in males was poor. Stripping commenced on 16th December (22 hens) and continued over an extended period of 7 weeks to 26th January 2009, when 15 hens remained unready to strip. This extended stripping period was also observed in the wild salmon broodstock. An estimated 500,000 green ova were produced by 145 Burrishoole hens (135 males). The average fecundity value was 3,468 per female. A proportion of each family was retained in the hatchery from five of the seven stripping dates, totalling 68,000 eyed ova (119 females).

An experimental population (53,800 eyed ova) consisting of 52 pure and hybrid families, was produced for the Beaufort Rough River Project, using eggs and milt from Owenmore and wild Burrishoole salmon. The project aims to determine the scale of biologically important local adaptation in Atlantic salmon using a common garden experimental approach.

Broodstock condition was good throughout the holding period, although regular formalin treatments were necessary from September to November, to control skin parasites. Ten hens were screened for the presence of *Anasakis* on 20th January 09 and levels were reported as low. Fish were tested by the Marine Institute Fish Health Unit in December and subsequently salmon ova were certified disease free. Ova quality and survival was good.

3.4 Rainbow Trout 2008

An estimated 6,082 0+ rainbow trout (Seven Springs NI) were stocked into Ballinlough Fishery from September to November 2008, and 2,270 trout were retained for stocking in 2009.

3.5 Sea lice vaccine research programme

In 2005, the Faculty of Veterinary Medicine UCD was awarded funding for the project 'Novel Vaccines for the Control of Sea Lice on Salmonids' through the NDP Marine RTDI Fund for collaborative research with the Aquaculture Section, ACMS. The objectives of this project are to identify and isolate novel sea lice vaccine candidates and to undertake studies that will identify parameters associated with immunological resistance to infection in vaccinated fish. The research programme consists of a number of work packages: identification of vaccine candidates, fish vaccination, sealice culture, infectivity trials and immunological studies. The fish production and vaccination components of this research programme are carried out using freshwater rearing facilities in Furnace.

In January 2008, 673 vaccinated (Norvac Compact 4) S½ salmon smolts were transferred to the Institute's experimental saltwater facilities in Galway on 3rd January and 20th February 2008, for immunological studies. On 28th February, 800 potential S1 smolts were vaccinated and branded, using 3 antigens and 4 adjuvants. Vaccinated S1 salmon smolts were transferred to the Institute's experimental saltwater facilities in Galway on 23rd April and 1st May 2008 for infectivity trials. In total, 2,400 S1/2 and 3,200 S1 salmon smolts were provided to the research programme from 2005 to 2008.

3.6 DIT Research programme

Mr. Paul Dunne continued proteomic research to investigate biochemical changes in Atlantic salmon mucus proteins and their role during the smolting period, as part of the Dublin Institute of Technology MPhil / PhD programme. No additional samples were taken in 2008.

Technological Sector Research: Strand 1 funding was awarded to DIT in 2006 for a project entitled: CODES: A Computerised Diagnostic Test System for determination of Atlantic salmon (Salmo salar) key developmental and disease states. Ms G. Ramaswamy continued research on this project during 2008.

3.7 Molecular biology of the Atlantic salmon

This research, funded by HEA PRTLI (2003-2006), aims to characterise gene expression profiles during the key life stages of Atlantic salmon, particularly smoltification and maturation, using functional genomics tools. In partnership with the Molecular Biology Group, National University of Ireland Galway, ACMS provided materials and services in support of this programme. Three postgraduate students continue to work towards completion of theses and publications.

Publications 2008

Somatolactin mRNA expression during the parr–smolt transformation in hatchery-reared Atlantic salmon *Salmo salar* smolts A. M. O'Keeffe, S. Hubert, M. Voisin, B. Houeix, D. Cotter, M. T. Cairns. Journal of Fish Biology (2008) 73, 436–443

4 WILD SALMON CENSUS PROGRAMME

NOTE: In 2006 and 2007 there was a problem related to the upstream counts of reared and probably wild salmon. The number of reared salmon displaced downstream prior to the spawning season was higher than the number of fish released upstream and the majority of these displaced fish had not been previously floy tagged in the upstream trap. While it has been difficult to identify the source of the problem, it seems likely to have been isolated to the Mill Race and maybe due to a gap in the fish fence screens.

In the 2006 and 2007 reports, the actual trap counts were presented as minimum upstream counts and the most likely scenario for a revised actual upstream count was also presented. How this was determined was included as Annexes to the 2006 and 2007 reports. Only the revised figures will be presented in 2008 and subsequently.

4.1 Wild Salmon and Grilse

A total of 548 wild grilse were recorded moving upstream through the permanent traps during the season (Table 4.1). The run commenced in June and was completed in December 2008 (Table 4.2). The main upstream grilse migration was recorded in the Salmon Leap trap with 491 grilse, compared to 57 grilse in the Mill Race trap.

The total number of spring fish recorded in the upstream traps was 23 (Table 4.3).

The retained rod catch of wild grilse on Lough Furnace was 1 fish. Therefore, the total wild grilse return, including the Furnace rod catch and the upstream count, was **549**.

Table 4.1. Monthly wild grilse totals for the Salmon Leap and Mill Race traps.

	Mill Race	Salmon Leap	Total
June	2	48	50
July	14	84	98
August	34	309	343
September	4	36	40
October	3	13	16
November	0	0	1
December	0	0	0
Total	57	491	548

Table 4.2. Monthly proportions (%) of wild grilse run 2004 -'08.

	2004	2005	2006	2007	2008
May	0.0	0.4	0.5	0.3	0.0
June	36.0	23.9	1.4	7.7	9.1
July	41.0	13.2	40.1	56.3	17.9
August	9.8	39.1	31.9	17.5	62.6
September	10.9	14.8	22.8	14.9	7.3
October	1.0	5.5	2.5	1.0	2.9
November	0.7	3.0	0.5	1.3	0.2
December	0.5	0.2	0.3	0.8	0.0

The late arrival of grilse to freshwater observed in 2006 and 2007 was again evident during 2008. Although water levels were sufficiently high for much of the summer the main upstream migration of wild grilse occurred during August when 62.6% of the run was recorded. The peak of the run the previous year occurred during July when 56.3% of the run was recorded.

Table 4.3. Wild salmon and grilse totals in upstream traps 1970-2008.

Year	Total Salmon	Total Grilse
1970-74	14	1145
1975-79	36	703
1980-84	35	449
1985-89	22	492
1990-94	16	421
1995	15	582
1996	18	409
1997	6	538
1998	4	516
1999	16	502
2000	6	568
2001	6	368
2002	2	648
2003	18	544
2004	28	580
2005	9	532
2006	31	530
2007	12	1049
2008	23	548

4.2 Net marked fish in upstream traps

In 2007, the Irish Government introduced a cessation on drift netting in Irish coastal waters. 2008 was the second year without drift netting and this was again reflected in the low incidence of net-marks on returning fish. The overall incidence of net marks recorded on wild grilse was 2.3% and on reared grilse was 1.4% (Table 4.4). Net marks were only recorded in wild fish during August and on reared fish in both July and August.

Table 4.4. Percentage Occurrence of Net Marks on Wild and Reared Grilse, 2008

	Wild Grilse	Reared Grilse
May	0.0	0.0
June	0.0	0.0
July	0.0	0.5
August	2.3	1.2
September	0.0	0.2
October	0.0	0.0
November	0.0	0.0
December	0.0	0.0
	n = 430	n = 1165

4.3 Wild Spawning Stock

The spawning stock represents the number of fish available for spawning (Table 4.5). It is calculated by subtracting rod caught fish and downstream-displaced fish as well as losses due to poaching, disease and predation, which have been estimated at 5% for wild fish and 10% for reared fish (Table 4.6).

In both 2006 & 2007, an additional number of fish, reared and wild, escaped upstream undetected (see previous reports). The overall conclusion was that although both wild and reared fish migrated upstream undetected the majority of reared fish were displaced downstream prior to spawning resulting in a low reared fish component in the spawning stock. It is likely that the wild grilse count for those years were a minimum figure and this is taken into account for all calculations based on the 2006 & 2007 spawning escapements (Table 4.6).

Table 4.5. Spawning escapement 1970 – 2008.

	Maximum spawning escapement	Wild fish component	Reared component
1970-74	1126	986	140
1975-79	725	683	42
1980-84	474	430	44
1985-89	662	428	232
1990-94	603	348	254
1995	464	376	102
1996	594	355	239
1997	494	466	28
1998	498	456	42
1999	547	485	62
2000	567	527	40
2001	370	349	21
2002	570	562	8
2003	517	506	11
2004	554	528	26
2005	503	472	31
2006	552	520	32
2007	1038	958	80
2008	512	495	17

Table 4.6. Spawning stock of salmon and grilse

	Wild grilse (1SW) & previously spawned grilse	Wild Salmon (2SW)	Ranched fish released upstream
Counted in trap	548	23	107
Rod Feeagh*	--	--	--
Culled	3	--	0
Broodstock	33	--	0
Estimated morts.	27	0	2
Displacement	12**	1	88
Spawning stock	**473**	**22**	**17**

* No angling on L. Feeagh during 2008.

** includes 2 used as broodstock

4.4 Survival from Ova to Grilse

The relevant brood year for the 2008 grilse was 2004 with ova hatch in 2005 and smolt migration in 2007 (Table 4.7). As in previous years, it has been assumed for the purpose of estimating survival that ranched grilse spawned naturally. Specific data are not available on differential survival rates of wild and ranched stocks spawned in the wild. All relevant calculations are based on parameters set out in the Ann. Rep. No. 19, 1974.

Table 4.7. Survival from ova to grilse

Spawning escapement in 2004	554
No. of females	277 - 305
Ova deposition	1,108,000 – 1,253,841
No. of smolts in traps 2007	6685
No. of smolts released	6518
Survival ova to smolt	0.53 – 0.60
No. returning grilse 2008	549
Survival smolt to grilse	8.4%
Survival to grilse per grilse female	***1.8 – 2.0***

4.5 Ova to Smolt Survival

The survival of ova to smolt ranged from 0.53 to 0.60% (Table 4.8).
The survival of smolt to grilse increased deceased from 12.8% in 2007 to 8.4% in 2008 despite the reduction in coastal exploitation.

The survival to grilse per grilse female was 1.8 – 2.0% (Table 4.9).

4.6 Wild Salmon Smolts

A total of 6909 wild salmon smolts were recorded in the downstream traps during 2008 (Table 4.9). This was an increase from 6685 recorded in 2007 (Table 4.10). The first peak occurred on the 5th May in the Salmon Leap with over 600 smolts recorded (Figure 4.1). Low water conditions from mid May reduced access for smolts to the downstream trap at the Salmon Leap. As a result the majority of smolts migrating were recorded in the Mill Race trap.

Table 4.8. Comparative data for the five-year averages from 1970 - 1989 and the values for the individual brood years from 1990 onwards.

Brood year-class	% survival rates ova to smolt	survival rates to grilse per grilse female spawner
1970-74	0.48 - 0.62	1.4 - 1.7
1975-79	0.63 - 0.73	1.5 - 1.7
1980-84	0.61 - 0.69	1.7 - 1.9
1985-89	0.44 - 0.45	1.4 - 1.5
1990	0.47 - 0.54	1.8 - 2.0
1991	0.47 - 0.53	1.8 - 2.0
1992	0.48 - 0.54	1.3 - 1.5
1993	0.39 - 0.45	1.5 - 1.6
1994	0.36 - 0.41	1.3 - 1.4
1995	0.83 - 0.93	1.9 - 2.1
1996	0.53 - 0.61	1.8 - 1.9
1997	0.52 - 0.59	1.4 - 1.5
1998	0.58 - 0.60	2.4 - 2.6
1999	0.79 - 0.70	1.8 - 2.0
2000	0.56 - 0.64	1.9 - 2.1
2001	1.30 - 1.10	2.9 - 2.6
2002	0.56 - 0.64	1.7 - 1.9
2003	0.68 - 0.76	3.7 - 4.1
2004	0.53 - 0.60	1.8 - 2.0

Table 4.9. Numbers of wild salmon smolts counted in 2008.

Month	SLDT	MRDT	Total
March	3	0	3
April	820	160	980
May	1624	3855	5479
June	230	156	386
July	50	7	57
August	2	2	4
TOTAL	2729	4180	6909

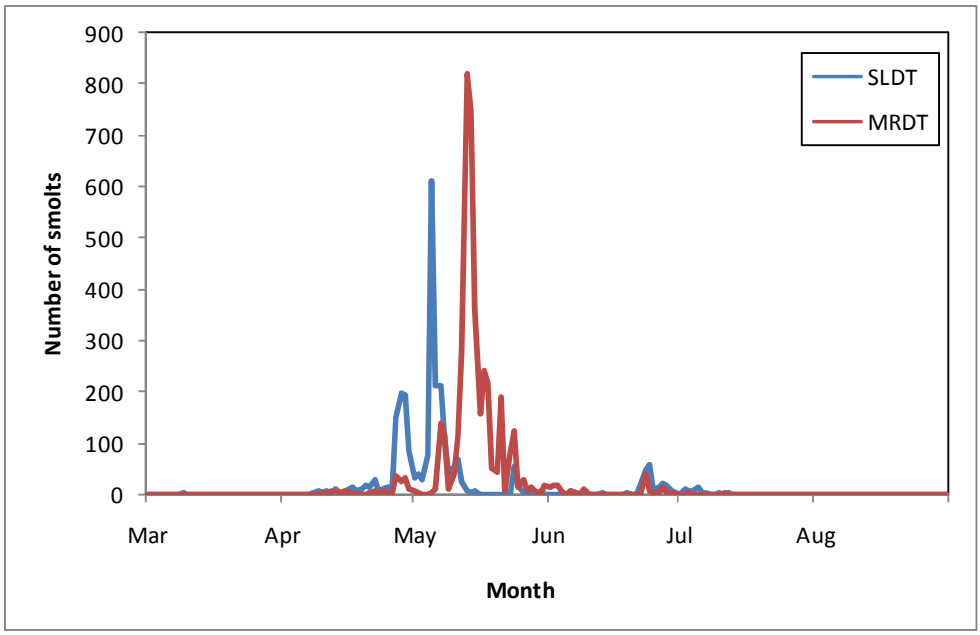


Figure 4.1. Timing of the 2008 wild salmon smolt run in the Salmon Leap & Mill Race traps.

Table 4.10. Annual numbers of wild salmon smolt recorded in downstream traps

1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
9588	7197	5791	6466	8627	7248	9316	7261	7918	6685	6909
8937*	7118*	5689*	6387*	8423*	7081*	9121*	7030*	7701*	6518*	6691*

* Number of smolts released to sea from traps when mortalities and samples were deducted.

6.7 Wild Salmon Kelts

The peak of the wild kelt run occurred during March which was a month later than the previous year (Table 4.11). This may have been a result of wild ripening later, as was observed in the commercial hatchery in 07/08 and therefore migrating later as kelts.

6.8 Tagging of wild kelts

Following the cessation of drift netting during 2007 and the corresponding increase in the wild spawning stock at Burrishoole tagging of the wild kelts recommenced during 2008. A total of 376 wild kelts were tagged with floy tags between January and May 2008 and 21 were recaptured in the upstream traps during the summer of 2008. The percentage recovery of previously spawned grilse during 2008 was 5.6% (Table 4.12).

Table 4.11. Numbers of wild salmon kelts counted in 2008.

	SLDT	MRDT	Total
January '08	49	15	64
February	50	4	54
March	217	10	227
April	132	12	144
May	7	1	8
Total	455	42	497

Table 4.12. Comparison of annual kelt runs:

	A	B	C	D	E
1975-79	75	18	14.0	30.0	8.1
1980-84	82	18	6.7	48.7	9.7
1985	94	26	3.0	56.0	7.7
1986	93	31	3.4	55.3	9.2
1987	68	15	10.8	22.6	9.7
1988	88	24	4.6	55.0	8.7
1989	96	11	3.7	27.0	6.6
1990	94	35	5.6	48.6	7.6
1991	98	39	3.4	82.3	9.7
1992	92	39	7.0	59.3	6.9
1993	83	5	3.2	52.7	7.4
1994	91	37	4.7	64.3	1.6
1995	74	28	18.3	59.9	2.3
1996	88.1	27	10.1	53.1	4.0
1997	93.7	33.5	6.3	58.9	*
1998	94.3	30.8	5.7	67.6	*
1999	90.6	38.5	4.5	76.0	*
2000	92.5	44.5	5.5	62.1	*
2001	97.0	38.5	2.8	72.5	*
2002	91.3	40.9	7.8	49.6	*
2003	95.5	37.0	3.5	42.3	*
2004	89.9	36.3	9.0	53.2	*
2005	83.3	35.5	15.3	57.6	*
2006	82.2	36.1	16.0	54.4	*
2007	95.0	37.3	4.1	**	*
2008	93.2	26.9	6.8	**	5.6

* no kelt tagging
** see section 4.7 (2007 report)
A = % healthy kelts in kelt run
B = % males in kelt run
C = % lightly marked
D = % survival from wild spawning escapement
E = % recapture of previously spawned grilse in first year

5. REARED SALMON CENSUS PROGRAMME

5.1 Coastal Returns

Details of coastal returns of Burrishoole fish are available in the Marine Institute 'National Report for Ireland - The 2008 Salmon Season' report.

5.2 Return rate of Reared and Wild grilse

A total of 1761 reared fish were cored during 2008 of which 1342 were identified as Burrishoole smolts released in 2007 and a further 17 as Burrishoole smolts released in 2006. The remaining fish were identified as experimental groups released both in 2006 and 2007.

The average return rate of reared Burrishoole grilse to freshwater, as determined by microtag recoveries was 6.3% and this compares with a return rate of 8.4% for wild grilse.

5.3 Recapture of Reared 2SW Fish

The total number of microtagged 2SW reared fish recorded in Burrishoole during 2008 was 17 comprising 4 release groups. It was noted that some of the 2SW weighed less than 2kg with the smallest weighing 1.3kg and 55.4cm.

5.4 Smolt Releases 2008

A total of 29,115 ranched smolts were released from Burrishoole during 2008. They consisted of 18,611 smolts released as part of the on-going core ranching programme and 10,504 smolts for an on going SLICE project. The core ranch smolts were released as two groups one on the 29th April and a second on the 6th May. Both groups were released directly into Lough Furnace.

The core groups were used as controls for the experimental SLICE groups, for further details on the experimental groups see Section 3.1.1.

2008 Microtagged smolt releases

Group ID	Tag Code	Mean Wt	Mean Length	No. Released	Date released
Slice	54741	89.4	19.57	6,980	29/04/2008
Slice	24767	89.1	19.43	3,524	06/05/2008
Core	34777	86.6	19.34	7,103	29/04/2008
Core	14781	85.8	19.45	3,496	06/05/2008
Core	54742	72.6	18.42	8,012	29/04/2008
R. Liffey	34781	63.6	17.16	5,552	27/03/2008
R. Liffey	34782	61	16.93	5,519	27/03/2008

6 WILD SEA TROUT CENSUS PROGRAMME

The sea trout research and monitoring programmes were continued in 2008.

6.1 Upstream Movements: Timing and Numbers.

A total of 40 wild silvered sea trout and a further 76 non-silvered trout migrated upstream through the traps in 2008. Of the silvered trout, 11 were adults and 29 (73%) were finnock. The numbers are compared with other years in Table 6.1. Of the total run of migratory trout (116), 66% were non-silvered. For the purposes of this report, the non-silvered trout are not included with the sea trout. Table 6.1 shows clearly that the numbers of sea trout have not recovered in the Burrishoole system and have shown a ten-fold drop since the 1970s.

Table 6.1. Annual runs of sea trout recorded in the traps.

YEAR	MILL RACE	SALMON LEAP	TOTAL	Amended Total
1970-74	1365	762	2127	
1975-79	829	1775	2604	
1980-84	458	780	1238	1719 *
1985-89	386	590	978	
1990-94	134	72	206	
1995-99	86	91	177	
1985	479	976	1465	
1986	277	1110	1387	
1987	528	422	950	
1988	497	366	863	
1989	147	77	225	
1990	101	54	155	
1991	180	162	342	
1992	123	28	151	
1993	130	43	173	
1994	136	74	210	
1995	90	90	180	
1996	112	85	197	
1997	65	72	137	
1998	56	50	106	
1999	107	157	264	
2000	33	78	111	
2001	31	58	89	
2002	26	89	115	
2003	45	33	78	
2004	26	64	90	
2005	5	10	15	
2006	16	22	38	
2007	35	59	94	
2008	4	36	40	

* See Table 34, Ann. Rep. XXX (1985); p. 43.

The timing of the sea trout run in 2008, and in previous years, expressed in monthly percentages, is given in Table 6.2. The highest proportion of sea trout, both finnock and

adults, moved upstream in August. The unsilvered trout moved upstream throughout the period with the majority in July and August.

Table 6.2. Timing of the Burrishoole sea trout run and unsilvered trout run (in monthly percentages). (n = no. of trout).

Silvered Trout

	1970-'79	1980-'84	1985-'89	1990-'94	1995-'99	2000-'04 (483)	2005 (15)	2006 (38)	2007 (94)	2008 (40)
May	-	0.2	0.5	0.1	3.1	2.0	6.7	0.0	0.0	0.0
June	13.1	24.6	9.4	8.4	8.6	16.7	26.7	0.0	16.1	0.0
July	54.4	44.9	62.2	55.0	42.4	37.5	0.0	10.5	53.8	10.0
August	15.8	10.3	18.4	16.5	19.3	26.4	60.0	26.3	15.1	82.5
September	7.6	14.8	3.7	8.5	9.8	5.7	6.7	44.7	10.8	5.0
October	6.4	3.5	4.1	7.9	12.2	10.2	0.0	15.8	3.2	2.5
November	2.4	1.5	1.5	2.9	4.3	1.5	0.0	2.6	1.1	0.0
December	0.3	0.2	0.2	0.7	0.7	0.0	0.0	0.0	0.0	0.0

Unsilvered Trout

	2005 (86)	2006 (61)	2007 (94)	2008 (76)
April			2.2	2.6
May	4.7	16.4	5.4	3.9
June	10.5	9.8	19.4	13.2
July	4.7	16.4	25.8	21.1
August	43	11.5	4.3	31.6
September	12.8	13.1	6.5	7.9
October	9.3	27.9	7.5	9.2
November	10.5	3.3	20.4	2.6
December	4.7	1.6	8.6	7.9

6.2 Spawning Escapement

With the continuation of the catch and release bye-law into the 2008 fishing season and the closure of L. Feeagh to angling, no sea trout were reported killed by anglers on L. Feeagh in 2008. Using the upstream fish counts through the traps, the total maximum spawning escapement of migratory trout to the L. Feeagh catchment was 116, of which 76 were non-silvered sea trout.

Table 6.3. Annual spawning escapement of sea trout into freshwater.

	1970-'79	1980-'84	1985-'89	1990-'94	1995-'99	2000-'04	2005	2006	2007	2008
Max. Escap	2090	1146	906	231	289	156	101	99	187	116
Revised	1622									

6.3 Downstream Movements, Sea Trout Smolts

The 2008 smolt run amounted to 393 smolts, of which 390 were released to the wild (Table 6.4). Few smolts were recorded from January to March. The main migration occurred in April and May and was strongly regulated by water level (Fig. 6.1). Few smolts migrated before a temperature of approximately 8°C was reached. The 2008 smolt run continued the trend of low numbers of smolts and was the lowest count recorded to date (Table 6.5).

Table 6.4. Monthly numbers of Burrishoole sea trout smolts recorded through the traps.

	Salmon Leap	Mill Race	Total	%
January	0	0	0	0.0
February	0	0	0	0.0
March	6	2	8	2.0
April	192	5	197	50.1
May	125	32	157	40.0
June	13	10	23	5.9
July	8	0	8	2.0
Total	344	49	393	
Number Released Downstream			390	

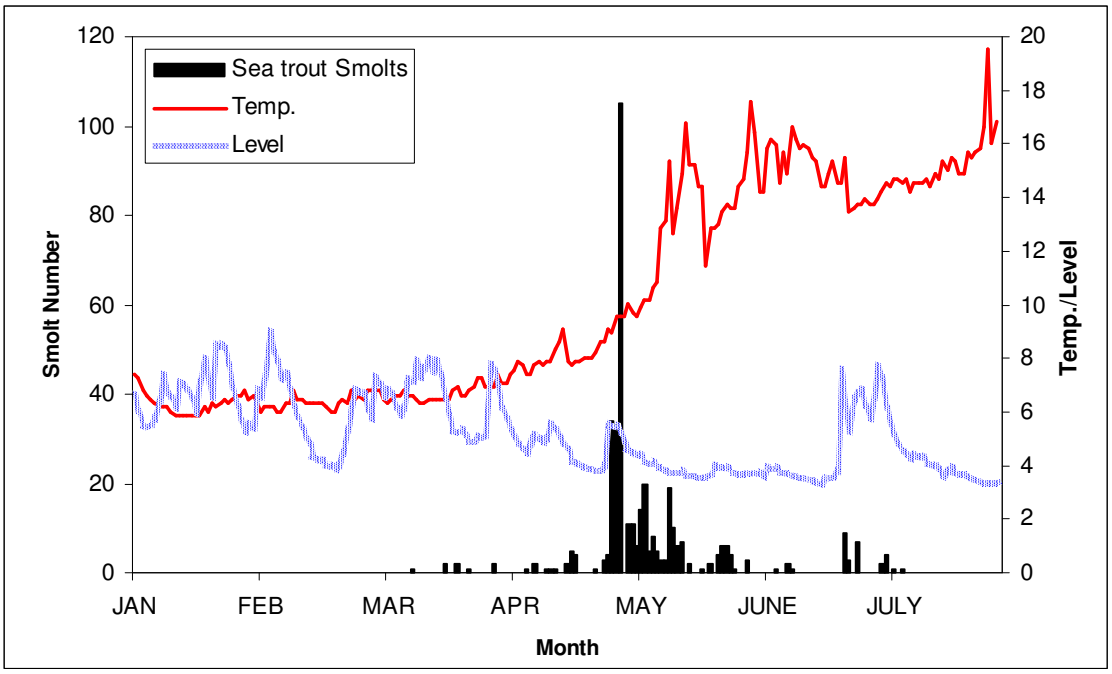


Fig. 6.1. Timing of the 2008 wild sea trout smolt migration with daily water level (m x 10) and temperature (^{0}C).

Table 6.5. Annual sea trout smolt numbers in Burrishoole for 1970 to 2008.

	1970-79	1980-84	1985-89	1990-94	1995-99	2000-04	2005	2006	2007	2008
Number	4176	4038	4119	1531	1361	816	777	626	593	393

A total of 86 wild smolts were measured in 2008. Length measurements were taken to facilitate an estimated age breakdown of the smolt run. The estimated statistics for the 2008 smolts were, mean length of 20.7 cm (similar to 20.0cm in 2007) and a range from 15.8 to 26.6 cm and the length frequency is presented in Figure 6.2. This gave an estimated age of 72% 2 year old and 28% 3 year olds.

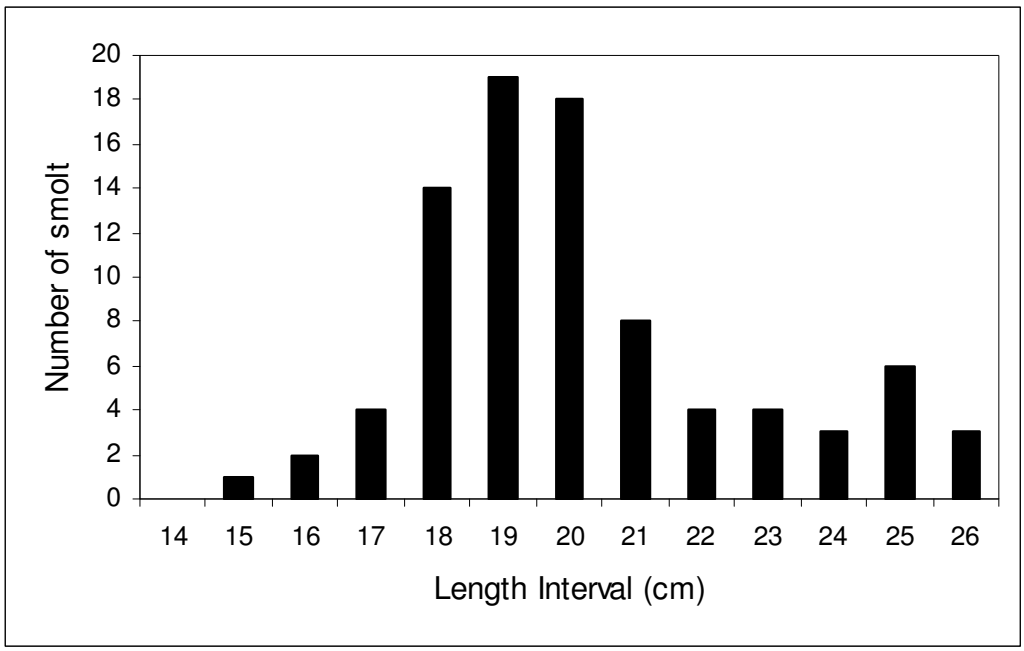


Fig. 6.2. Length distribution for smolts in the Burrishoole system, 2008 (n=86).

6.4 Autumn Migrating Smolts

These are juvenile trout (*Salmo trutta* L.) which generally move downstream through the traps from August to December. It is not clear whether these are true sea trout or part of the resident trout stock, should a difference exist. These runs of trout would appear to becoming more prolonged with substantial numbers of un-silvered 0+ and 1+ trout continuing to migrate downstream in the early months of the year. A total of 689 trout entered the traps between July and December 2008 and up to June 2009 (Table 6.6). The percentage of 0+ trout that migrated over the period was 28.2% (Table 6.7).

Table 6.6. Numbers of migrating autumn juvenile trout in 2008, to the end of June 2009.

Month	0+ SL	0+ MR	1+ SL	1+ MR	Total SL	Total MR
July	2	0	2	0	4	0
August	6	2	24	6	30	8
September	44	3	44	5	88	8
October	50	2	109	14	159	16
November	24	0	111	0	135	0
December	30	0	87	8	117	8
January 2009	15	2	27	4	42	6
February 2009	8	0	7	1	15	1
March 2009	3	0	25	1	28	1
April 2009	0	2	9	9	9	11
May 2009	0	1	1	0	1	1
Total	182	12	446	49	628	61
Overall Total	194		495		689	

Table 6.7. Percentage of 0+ juvenile trout in the trapped autumn migrating trout.

1982	50	1996	34
1983	N/A	1997	18.7
1984	55.8	1998	33.5
1985	30.3	1999	42
1986	16.1	2000	47.8
1987	35.3	2001	56.3
1988	60.9	2002	32.8
1989	37.2	2003	48.9
1990	35.2	2004	35.5
1991	26	2005	37.3
1992	38.2	2006	51.2
1993	27.6	2007	27.9
1994	16.8	2008	28.2

1995	25.3

6.5 Total Recruitment

The 0+ autumn trout will not be large enough to become sea trout smolts in the following spring. The remainder, predominantly 1+ years old, could contribute to the overall recruitment of sea-run trout the following year. The exact proportion of 1+ autumn trout that become smolts in any given year is not known.

It is only since 1982 that the proportion of 0+ trout amongst the autumn migration has been estimated. Thus the figures for total recruitment up to this time are over-estimated (Table 6.8).

From 1982, total recruitment was calculated by adding the number of sea trout smolts produced in any one year to the total of 1+ autumn trout the previous year (Table 6.9). The assumption is made that all the 1+ autumn trout will become sea trout smolts and that no 0+ trout from the two years previous will be recruited as smolts. The fate of 1+ unsilvered juveniles migrating downstream in January to May is unknown but it would seem unlikely that these will contribute to the 2 year old spring smolt migration.

Table 6.8. Estimates of total migrant trout recruitment up to 1981.

YEAR	SMOLT TOTAL	AUTUMN TROUT (preceding year)	TOTAL RECRUITMENT
1970-74	4450	2870	6746
1975-79	4314	3186	7489
1980	2337	2351	4688
1981	6710	2631	9341

Table 6.9. Estimates of total migrant trout recruitment from 1982.

YEAR	SMOLT TOTAL	AUTUMN TROUT 1+ & Older (preceding year)	TOTAL RECRUITMENT
1982	3907	1300*	5207*
1983	4852	1109	5961
1984	2383	1200*	3583*
1985	4238	611	4894
1986	3454	1472	4926
1987	3371	1726	5097
1988	4290	949	5239
1989	3179	556	3735
1990	2022	634*	2656*
1991	2137	636	2773
1992	1936	234	2170
1993	1720	183	1903
1994	1127	306	1433
1995	1821	282	2103
1996	1300	336	1636
1997	817	513	1330
1998	1608	717	2325
1999	1260	644	1904
2000	769	358	1127
2001	530	218	748
2002	1272	910	2100
2003	787	976	1763
2004	723	426	1149
2005	777	590	1367
2006	628	251	879
2007	593	377	970
2008	393	534	927

* estimated

6.6 Marine Survival

An estimate of sea trout survival to first return to freshwater can be more accurately calculated by the use of trap census data rather than rod catch returns of tagged or marked fish. Small numbers of stray fish are captured in other systems and it is not known whether these fish would have returned to their natal systems to spawn. Finnock are known to wander between river systems and are therefore not as reliable for assessing survival.

The pattern of marine survival found is similar whether the number of smolts is used or the combined total recruitment of smolts and autumn 1+ trout. The percentage of smolts that

return as finnock in the same year historically ranged from 11.4% to 32.4% (Fig. 6.3). In 1988 it fell below the previous recorded minimum to 8.5% and in 1989 to a minimum of 1.5%. There has been a saw-tooth pattern of finnock return in the 1990's rising to 16.7% in 1999 – the highest return rate since 1986. This increase was not, however, sustained in subsequent years and there was a collapse in 2005 down to 1.5%. This was associated with the heaviest infestations of sea lice observed in the Burrishoole area since 1992.

The total survival of smolts to the first return to freshwater as finnock in the same year and one year old sea trout in the following year (always an over-estimate as a proportion of finnock re-entering freshwater in year 1 return as sea trout in year 2 (Mills *et al*, 1990)) also shows a drop in survival from 1987 to 1989 (Fig. 6.4).

Historically, the total survival to first return ranged from 19% to 66%. This collapsed to 1.8% in 1989 but rose to 12.1% in 1990. However, little further improvement was recorded in 1991 (12.8%). Marine survival fell to the second lowest level in 1992 but returned to 13.1% for the 1993 year class of smolts. There was a further increase in 1994 to 18.2% but a drop in 1995 to 8.1%. There were marginal improvements again in 1996 (12.8%) and 1997 (13.3%), a drop to 8.3% in the 1998 year class and a marked improvement in the 1999 year class where marine survival was 20%, the highest recorded in 12 years and within the pre-collapse historical range.

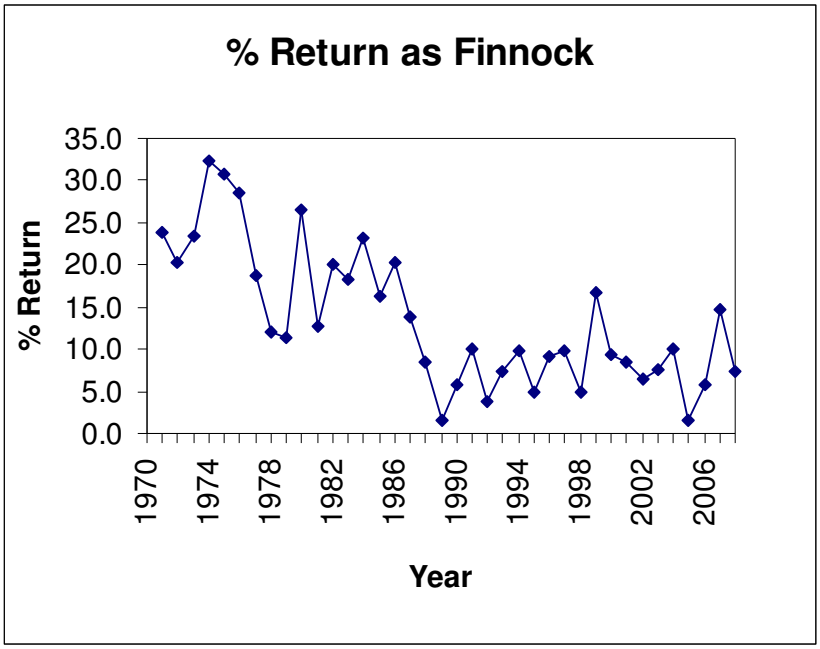


Fig. 6.3. Annual percentage return of smolts returning as finnock to the Burrishoole system.

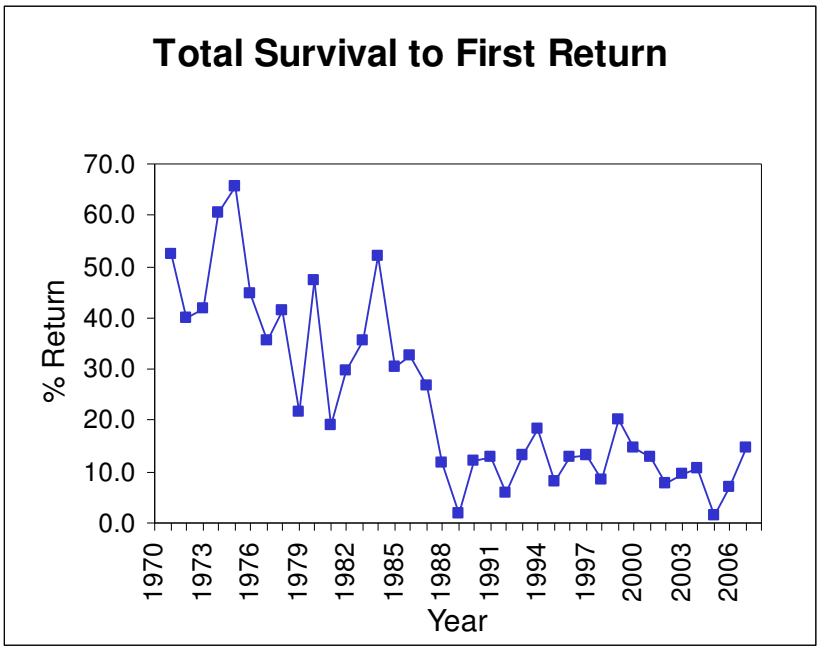


Fig. 6.4. Annual marine survival of smolts to first return (as finnock and 1+ sea trout) to the Burrishoole system.

6.7 Sea Trout Kelts

Table 6.10 gives the numbers of sea trout and brown trout kelts, both spawned and immature, counted downstream in the winter of 2007 and spring of 2008.

The freshwater survival of kelts is given in Table 6.11. In some years, the number of kelts migrating downstream has exceeded the number of upstream migrants. This occurred in the early '80s when the screen allowed finnock to escape. This was rectified. More recently, the difficulty in separating small finnock and large smolts has led once again to a discrepancy as shown in Table 6.11. In addition to the size overlap, trout counted upstream as unsilvered migrants may be counted downstream as silvered kelts, causing difficulties in making survival estimates.

Since 1987, only one survival rate has been given for all sizes as it has been shown that a proportion (at least 33%) of the sea trout population may over-winter in freshwater. These fish do not spawn and continue to grow. There is also the additional complication of larger smolts and reduced sea growth mentioned above. Thus the comparisons of the proportion of fish in different year classes between the upstream migrants of one year and the downstream migrants of the next are invalidated.

Table 6.10. Timing and numbers of sea trout kelts for the 2007/2008 season.

Month	Large ST	Small ST	BT	Total ST	Total Trout
October '07	0	3	5	3	8
November	1	3	41	4	45
December	2	9	66	11	77
January '08	2	4	36	6	42
February	2	12	12	14	26
March	4	16	26	20	46
April	10	20	37	30	67
May	0	1	1	1	2
June	0	0	0	0	0
Total	21	68	224	89	313

Table 6.11. Annual survival rate to sea trout kelt, as % of the upstream escapement of the previous year.

Year	Larger (> 30.0 cm)	Small (< 30.0 cm)
1976	79	66
1977	63	45
1978	50	66
1979	33	107*
1980	50	82
1981	44	345*
1982	53	203*
1983	63	177*
1984	74	210*
1985	70	98
1986	66	72
1987	58.7% (combined)	
1988	65.5% "	
1989	68.7% "	
1990	79.0% " *	
1991	98.7% " *	
1992	89.5% " *	
1993	96.7% " *	
1994	104.6% " *	
1995	96.2% " *	
1996	127.7% " *	
1997	97.0% " *	
1998	140.1% " *	
1999	110.4% " *	
2000	70.1% "	
2001	82.0% " *	
2002	129.6% " *	
2003	66.1% "	
2004	120.5% "*	
2005	142.2% "*	
2006	110.5% "	
2007	228.9% "*	
2008	98.9% "*	

* Years when the number of finnock kelts counted downstream exceeded the number counted upstream during the previous season.

7 SILVER EEL CENSUS PROGRAMME

Silver eel trapping was continued in 2008. The main run occurred in September and October (Table 7.1). Figure 7.1 shows the daily counts of silver eels in relation to changes in water level. The main runs of eels were closely related to increases in level.

The total run amounted to 2252 eels. As in other years, the highest proportion of the total catch (76.7%) was made in the Salmon Leap trap.

Table 7.1. Timing and numbers of the 2008 silver eel run.

	Salmon Leap	Mill Race	Total	%
June	3	1	4	0.2
July	8	2	10	0.4
August	191	53	244	10.8
September	331	106	437	19.4
October	1059	349	1408	62.5
November	128	9	137	6.1
December	5	3	8	0.4
Jan. 2009	3	1	4	0.2
Total	1728	524	2252	

Sampling of individual eels (n = 800) gave an average length of 48.3 cm (range: 30.0 – 98.9 cm) and an average weight of 234 g (Table 7.2). The length frequency distribution is presented in Figure 7.2 along with those for 2006 and 2007 for comparison.

Catches of silver eel between the years 1971 (when records began) and 1982 averaged 4,400, fell to 2,200 between 1983 and 1989 and increased again to above 3,000 in the '90s (Fig. 7.3). There was an above average catch in 1995, possibly contributed to by the exceptionally warm summer. The catch in 2001 of 3875 eel was the second highest recorded since 1982. The average weight of the eels in the catches has been steadily increasing from 95 g in the early 1970s to 215 g in the 1990s (Fig. 7.3).

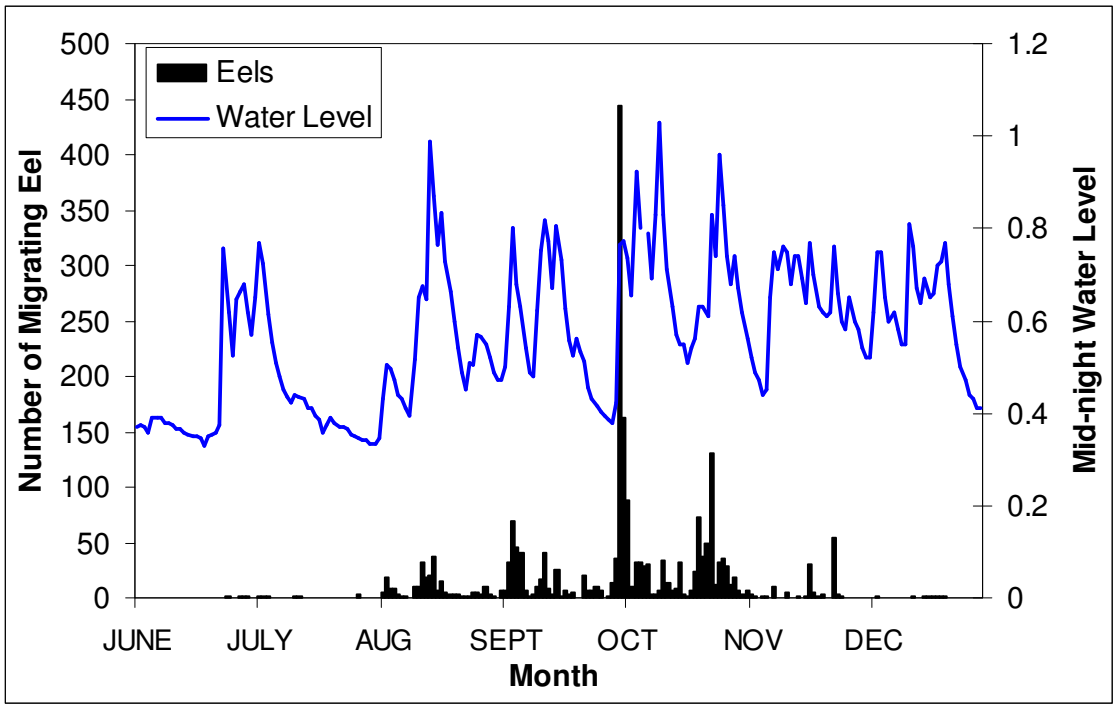


Fig. 7.1. Daily counts of downstream migrating silver eel and mid-night water levels.

Table 7.2. Comparative data for the silver eel runs since 1971

Years	Number Sampled	Mean. Weight (gm)
1971 - '75	4465	84
1976 - '80	4023	115
1981 - '85	2678	171
1986 - '90	11658	196
1986	1856	194
1987	2713	195
1988	3283	206
1989 *	685	254
1990	3121	176
1991	266	246
1992	523	186
1993	181	260
1994	468	220
1995	2003	225
1996	1172	184
1997	1022	238
1998	845	208
1999	577	220
2000	342	212
2001	850	238
2002	732	207
2003	650	177
2004	382	216
2005	587	237
2006	493	225
2007	571	201
2008	796	234

* Incomplete due to flood damage

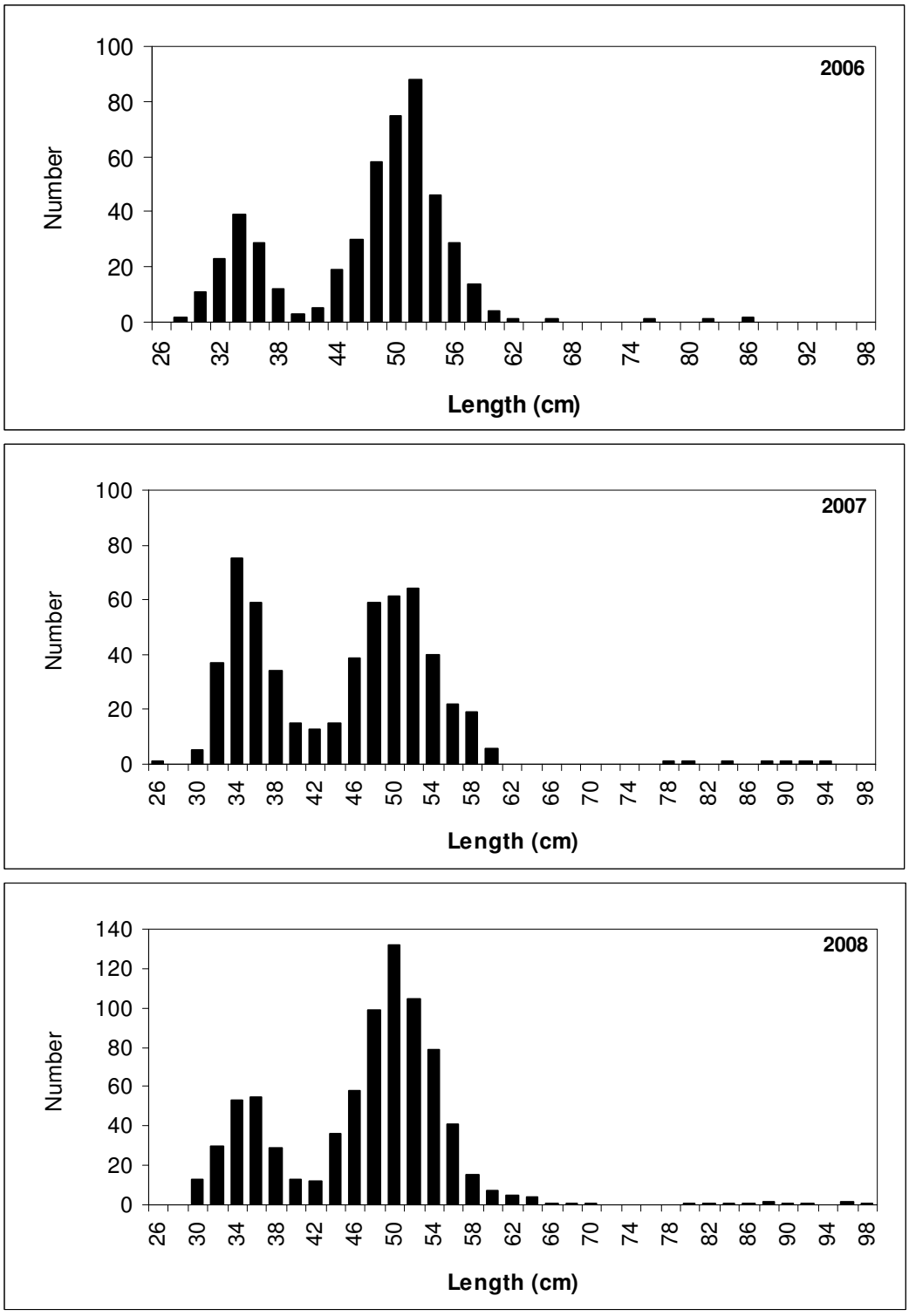


Fig. 7.2. Length frequency of silver eels trapped in the downstream traps, 2006 (n=493), 2007 (n=571) and 2008 (n=800).

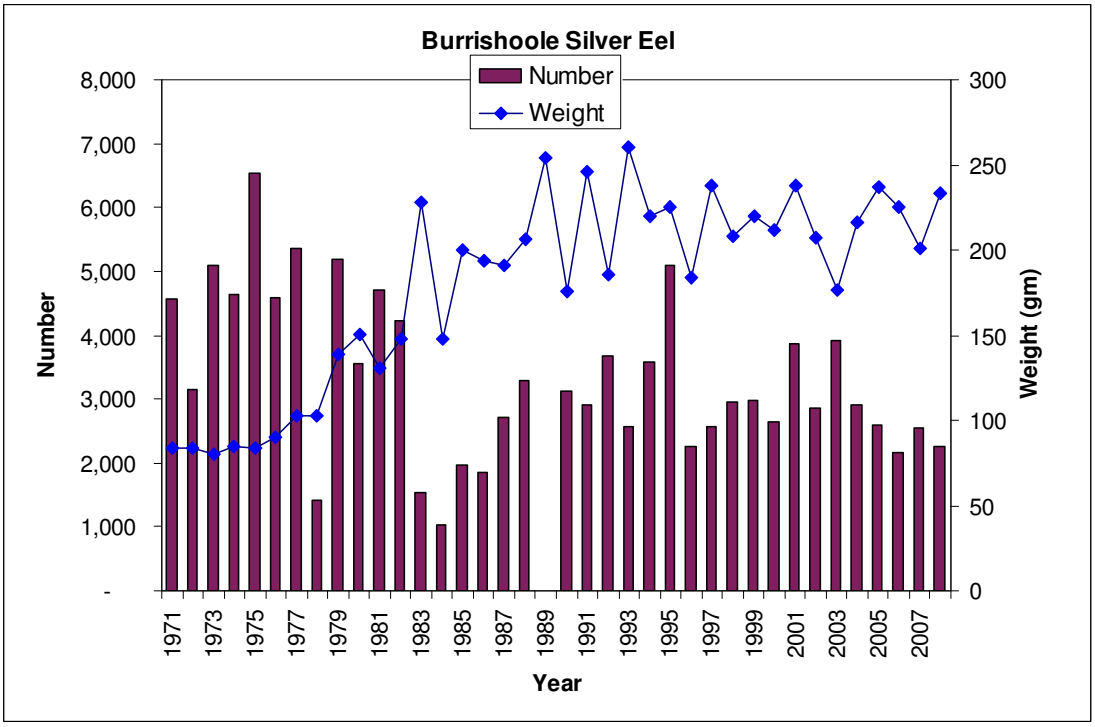


Fig. 7.3. Annual number and mean weight of silver eels trapped in the downstream traps.

8 FISHERY REPORT - CATCH DATA

8.1 Numbers and Average weight of Rod Catch

During 2008 angling was carried out on Lough Furnace from June to September. Lough Feeagh, which had been closed to angling since 1997 for conservation reasons, was opened to angling for the month of September on a catch and release basis.

The total catch of wild and reared salmon was 168 fish, 52 wild salmon and 116 reared salmon. For conservation purposes 51 of the wild fish were returned alive.

The Lough Furnace catch consisted of 34 wild fish and 115 reared fish and the Lough Feeagh catch consisted of 18 wild grilse and 1 reared fish.

The average weight of reared salmon was 2.0 kg (n=114); the heaviest reared fish 3.3 kg. and the smallest was 0.7kg. No lengths or weights are available for wild fish.

A total of 21 sea trout were caught on Lough Furnace and 3 on Lough Feeagh. Regulations remained in place whereby all rod caught sea trout were returned alive.

In addition to the sea trout caught on Lough Feeagh a total of 761 brown trout were also caught.

8.2 Timing of Catch and Rod Effort

The timing of rod catch in 2008 was influenced by the late arrival of fish into Lough Furnace. Returns to the upstream traps would suggest that salmon had returned later in the season to freshwater in 2008, 62.6% of the wild return was recorded during August. The highest catches of both wild and reared salmon on Lough Furnace also occurred during August.

The rod effort at Burrishoole continued to show an increase in recent years from 2065 hrs in 2006 to 3216 hrs in 2007 and 3781.5 in 2008. The 2008 effort consists of 3449.5 hrs on Lough Furnace and 332 hrs on Lough Feeagh (Table 8.1).

Table 8.1. Wild and reared salmon rod catch and rod effort (hours) for the 2008 season for L. Furnace and L. Feeagh.

Furnace

	Salmon Catch		Effort in hours
	Wild	Reared	
May	0	0	0
June	4	13	246
July	8	30	1601
August	21	71	1408
September	1	1	195
Total	34	115	3450

Feeagh

	Salmon Catch		Effort in hours
	Wild	Reared	
May	0	0	0
June	0	0	0
July	0	0	0
August	0	0	0
September	18	1	332
Total	18	1	332

8.3 Exploitation Rates of Rod Fishery

Rod exploitation rates for Lough Furnace and Lough Feeagh from 1990 to 1996 are shown in Table 8.2. From 1997 onwards Lough Feeagh was closed to angling. Exploitation rates are only available for Lough Furnace since 1997. The cessation of angling on Lough Feeagh was due to the continuing low stock level of wild fish. Following the cessation of drift netting in 2007 and the increased return of wild fish it was decided to open Lough Feeagh in 2008 to angling for the month of September only on a catch and release basis for both wild and ranched fish. No sea trout angling was permitted on L. Feeagh since 1997.

Anglers fishing on Lough Furnace were requested to return wild fish alive to the water. Injured or damaged wild fish were permitted to be retained; therefore, the rod catch on Lough Furnace consists of a total catch which includes released fish and a retained catch which are fish that have been killed.

Rod exploitation rates for Lough Furnace and Lough Feeagh from 1990 to 1996 are shown in Table 8.2.

Table 8.2. Rod Fishing Exploitation Rates (1999-2008)

	2000	2001	2002	2003	2004	2005	2006	2007	2008
WILD SALMON									
Lough Feeagh									
"Available" fish by end of fishing season	*	*	*	*	*	*	*	*	531
Total rod catch									18
Rod catch retained									0
Angling success %[1]									3
Exploitation rate %[2]									0

WILD SALMON	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
Loughs Feeagh & Furnace									
Total stock of wild fish	580	375	651	565	610	542	566	1063	572
+ 10% addition for L. Furnace population	638	413	716	622	671	596	623	1169	629
Total catch of wild fish	70	17	12	373	10	27	48	26	52
Rod catch retained	6	1	1	2		1	5	2	1
Max. angling success %	12.1	4.5	1.8	6.5	1.6	5.0	8.5	2.4	9.1
Min. exploitation rate	0.9	0.2	0.14	0.5	0.3	0.2	0.9	0.2	0.2
Max. exploitation rate	1.0	0.3	0.15	0.5	0.3	0.2	0.8	0.2	0.2

REARED SALMON	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
Lough Feeagh									
"Available" fish by end of fishing season	*	*	*	*	*	*	*	*	98
Total rod catch									1
Rod catch retained									0
Angling success %[1]									1.0
Exploitation rate %[2]									0.0
Loughs Feeagh & Furnace									
Total stock	1257	834	860	1178	902	952	954	2624	1865
Total rod catch	129	43	10	22	64	28	66	169	116
Exploitation rate %	10.3	5.2	1.2	1.9	7.1	2.9	6.9	6.4	6.2

WILD SEA TROUT	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
Lough Feeagh									
"Available" fish by end of fishing season	*	*	*	*	*	*	*	*	39
Rod catch									3
Exploitation rate %									0

8.4 Angling Success

Table 8.3. Catch per unit effort (CPUE) and effort per unit catch (EPUC) for the Burrishoole Fishery

	Lough Furnace				Lough Feeagh			
	Salmon		Sea Trout		Salmon		Sea Trout	
Year	CPUE	EPUC	CPUE	EPUC	CPUE	EPUC	CPUE	EPUC
'80-'84	0.13	9.92	0.85	1.35	0.23	4.47	0.63	2.1
'85-'89	0.24	4.89	0.46	5.09	0.24	4.57	0.29	70.3
'90-'95	0.2	6.1	0.17	16.8	0.2	5.4	0.1	14
'96	0.22	4.4	0.1	10.5	0.83	1.2	0.3	2.9
'97	0.17	6	0.1	9.6	*	*	*	*
'98	0.44	2.3	0.08	13.2	*	*	*	*
'99	0.09	10.8	0.05	20.8	*	*	*	*
'00	0.3	3.31	0.06	16.5	*	*	*	*
‘01	0.15	6.7	0.12	8.4	*	*	*	*
’02	0.12	8.3	0.07	15.3	*	*	*	*
’03	0.13	7.6	0.06	17.7	*	*	*	*
’04	0.22	4.6	0.16	6.3	*	*	*	*
’05	0.26	3.8	0.08	13	*	*	*	*
’06	0.44	2.3	0.04	23.5	*	*	*	*
’07	0.49	2.1	0.14	6.9	*	*	*	*
’08	0.35	2.89	0.05	21.6	0.46	2.18	0.07	13.8

Annex 1: Macroinvertebrate Survey of rivers in the Burrishoole and Owengarve catchments, 2008: E. de Eyto

Introduction

The research facility in Furnace is ideally placed for the collection and analysis of data applicable to the long term monitoring of lotic and lentic freshwater habitats. In 2003, we implemented a formal, consistent macroinvertebrate monitoring plan, which will hopefully be continued long term to enable annual trends in water quality to be captured. We have now collected 6 years continuous data.

The main land uses in the Burrishoole catchment are forestry and agriculture. The agriculture is mainly hillside subsistence farming, with large numbers of mountain sheep. About 18% of the Burrishoole catchment and 7% of the Owengarve catchment is under active coniferous forestry plantations, which were planted in batches starting in the 1970's. The base geology on the west side of the Burrishoole catchment (Glenamong, Altahoney and Maumaratta subcatchments) is predominantly quartzite/schist, making them acidic in nature, with poor buffering capacity. On the east side of the catchment (Rough, Lodge, Goulaun and Cottage subcatchments) , the geology is much more complex and while there is also quartzite/schist, it is interspersed with veins of volcanic rock, dolomite, wacke and pure schist, which means that the buffering capacity is higher as is the aquatic production. The Owengarve catchment is split in half with quartzite/schist in the northern half, and sandstone in the southern half (Fig. 1).

Methods

Macroinvertebrate samples were sampled in May 2008 from two sites in each of the main Burrishoole subcatchments, and two sites in the Owengarve catchment (Fig. 2). Three replicate 1ft sq surber samples were taken from riffle / stony areas. Samples were stored in >70% IMS and sorted and identified using standard keys in the laboratory. Data was collated at both taxa and order level and was combined with data from 2003, 2004, 2005, 2006 and 2007. Biotic indices (ASPT, BMWP, Q index, No. of taxa, No. of EPT taxa, acidity index) were also calculated for each site.

Results and discussion

A total of 1401 individual macroinvertebrates, representing 28 taxa, were sorted and identified from the 2008 samples. This is the lowest number of taxa found since the program started in 2003 (Table 1). The average number of animals per sample ranged from 11 ± 5 (s.d) in the Glenthomas river to 83 ± 43 in the Glendahurk river (Fig. 3). Highest numbers of taxa were sampled from the top of the Goulaun river and two sites in the Cottage river (Fig. 4). As in previous years, the macroinvertebrates on the Burrishoole and Owengarve catchments in 2008 were dominated by Ephemeroptera, Diptera, Plecoptera, Coleoptera and Trichoptera (Fig. 5).

The use of biotic indices helps to condense all the taxa and assemblage information into single values, and indices were calculated for the six years data to date (2003-2008). Several of these indices are specifically designed to monitor nutrient enrichment (Q index, ASPT, BMWP) (Hawkes, 1997; McGarrigle *et al.*, 2002) while the acidity index is used to monitor acidification (Henrikson and Medin, 1986). The Shannon diversity index gives an overall view of the diversity at each site (Fig. 6), and ranged between 1.1 and 2.7 in 2008. The number of EPT taxa (Ephemeroptera, Plecoptera and Trichoptera), which are indicative of

high water quality, ranged from 3 to 9 in 2008 (Fig. 7). The BMWP (Biological Monitoring Working Party) score ranged from 32.7 to 92.5 in 2008 (Fig. 8). A BMWP score of greater than 100 are associated with clean rivers, while heavily polluted rivers would score less than 10, so the BMWP scores for our sampling sites suggest that our rivers are not been impacted by nutrient enrichment. The ASPT scores (which are calculated by dividing the BMWP score by the number of taxa, to standardise for sample size) ranged from 6.3 to 7.9 in 2008 (Fig. 9). The BMWP, ASPT and Q index (rivers were either 3, ¾ or 4 – Fig. 10)) generally do not tell us much about our rivers, except to show that nutrient enrichment is not really an issue at the moment in these rivers. A more insightful index is the acidity index, which is calculated using several metrics related to acid sensitive species, and general macroinvertebrate diversity. The acidity index ranged from 1 to 8 in 2008 (Fig. 11) and the index is fairly consistent within sites sampled across the six years. This indicates that this index is quite robust. The Altahoney and Maumaratta generally have the lowest values in all years, indicating that the macroinvertebrates assemblages in these rivers are a very good reflection of the acid nature of the water. The acidity index ranges from 0-14, and the Swedish EPA recommends that a river that is unaffected by acidity (in reference conditions) would have an acidity score of at least 6. Some of the rivers in the Burrishoole and Owengarve catchments are well below this, and while it is largely a reflection of the underlying geology, it seems likely that the very low scores (1-3) are a reflection of the impact of forestation.

Several sites recorded lower than normal acidity scores in 2008, notably the Glenthomas, the bottom of the Goulaun and the two sites on the Rough river. In the case of the Glenthomas site, all the biotic indices recorded were lowest in 2008, indicating a drop in ecological quality at this site. On closer examination, there has been a drop in the number of taxa sampled, and a decrease in the number and abundance of sensitive species (Fig. 12). In 2008, no sensitive species were recorded in the Glenthomas, and the main abundance of macroinvertebrates comprised dipteran larvae (Chironominae, Orthocaldinae and tanypodinae). While the presence of these larvae does not indicate poor ecological quality, the absence of more sensitive species such as mayflies, caddifles and stoneflies is worrying. The only EPT taxa present in 2008 was *Leuctra hippopus* which is the one stonefly that is not classed as sensitive (EPA Q index, McGarrigle et al, 2002). It was noted at the time of sampling that there were very few individuals in the samples, and in fact, several extra samples were taken to check whether it was sampling error or a real lack of animals that contributed to the low numbers captured. All the extra samples had similarly low numbers. Thus, we must conclude that the ecological quality in the Glenthomas was low in 2008.

There were no amphipods or acid sensitive ept species found at the site at the bottom of the Goulaun river, and generally the species richness and abundance of sensitive species was low at this site (Fig. 13). In 2008, the macroinvertebrate community was composed primarily of tolerant beetle and fly taxa, along with *Baetis rhodani* and *Leuctra hippopus*. This is very similar to the situation in the Glenthomas river.

With regard to the Rough river (Srahrevagh), 2008 showed a continuing decline in ecological quality at the bottom of the river, which was first observed in 2006 (Fig. 14). The absence of amphipods in samples taken in 2006 and 2008 is the main contributing factor to the low acidity score, but the lake of any sensitive species in 2008 is worrying (Fig. 14, blue or green columns indicate group A or B species from the EPA's q index). Like the two sites mentioned above, the 2008 samples were dominated by tolerant beetles and dipterans. The acidity index was also low at the top site on the Rough owing to an absence of acid sensitive species. One possible reason for the observed decline in the rough river may be increased felling operations in the upper catchment. This may also be having an impact on the Goulaun river. It is worth

noting however that the total number of taxa and the number of EPT taxa was low in 2008, possibly as a result of weather conditions in the latter half of 2007 and the start of 2008. So far, it looks like 2009 is displaying a different weather pattern to that observed in 2008, so it will interesting to see whether the low quality indices described above can be attributed to climactic conditions or land use changes.

Acknowledgements
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Table 1. Macroinvertebrate taxa sampled from the Burrishoole and Owengarve catchments, 2003-2008

Order		2003	2004	2005	2006	2007	2008
Total Taxa		**61**	**83**	**62**	**37**	**44**	**40**
Acari	Hydracarina	x	x	x		x	
Amphipoda	Gammarus duebenii	x	x	x	x	x	x
Coleoptera	Coleoptera			x			x
	Dryopidae		x			x	
	Dytiscidae	x	x			x	
	Elmis aenea	x	x	x	x	x	x
	Esolus parallelepipedus	x	x	x		x	x
	Gyrinidae		x				
	Helodidae	x	x	x	x	x	
	Hydraenidae	x		x			
	Hydroporinae		x	x	x	x	
	Hygrobiidae		x				
	Limnius volckmari	x	x	x	x	x	x
	Noteridae						x
	Oulimnius tuberculatus	x	x	x		x	
	Stenelmis canaliculata		x				
Collembola	Collembola	x	x				
Diptera	Chironomidae	x	x	x		x	x
	Chironominea	x	x	x	x	x	x
	Culicidae	x	x	x	x		
	Dicranota	x	x	x	x	x	x
	Diptera	x		x			
	Orthocladinae	x	x	x	x	x	x
	Ptychopteridae		x				
	Simulidae	x	x	x	x	x	x
	Tabanidae		x	x			
	Tanypodinae	x	x	x	x	x	x
Ephemeroptera	Baetis atrebatinus	x				x	
	Baetis rhodani	x	x	x	x	x	x
	Baetis sp.					x	x
	Caenidae			x			
	Caenis macrura	x					
	Caenis rivulorum	x	x		x	x	
	Caenis horaria		x				
	Centrophilum luteolum		x	x			
	Ecdyonurus	x					
	Ecdyonurus insignis	x	x				
	Ecdyonurus dispar		x	x			
	Ecdyonurus torrentis			x			
	Ecdyonurus venosus	x	x	x	x	x	
	Ephemerella ignita	x	x	x	x	x	
	Ephemerella notata		x	x			
	Ephemeroptera			x			
	Heptagenia			x	x	x	x
	Heptagenia lateralis	x	x	x			

Table 1. (Cont.)

Order		2003	2004	2005	2006	2007	2008
Ephemeroptera	Heptagenia sulphurea		x				
	Heptagenidae		x				x
	Leptophlebia	x	x				
	Rhithrogena germanica			x			x
	Rhithrogena semicolorata	x	x	x	x	x	x
Hemiptera	Veliidae		x				
Hirudinea	Hirudinea		x				
Mollusca	Ancylus fluviatilis	x		x			
	Hydrobia ulvae	x					x
	Hydrobiidae			x			
	Pisidium			x	x		x
	Potamopyrgus jenkinsi	x	x		x	x	
	Prosobranchia						x
Odonata	Anisoptera			x			
Oligochaete	Oligochaete	x	x	x	x	x	x
Ostracoda	Ostracoda		x				
Platyhelminthes	Platyhelminthes	x					
Plecoptera	Amphinemura sulciollis	x	x	x	x	x	
	Chloroperla torrentium	x	x	x	x	x	x
	Diura bicaudata	x					
	Isoperla grammatica	x	x	x	x	x	x
	Leuctra hippopus	x	x	x	x	x	x
	Leuctra inermis	x	x				
	Leuctra fusca		x	x			
	Nemoura cinerea		x		x	x	
	Perla bipunctata		x				
	Perlodes microcephala		x				
	Perlodidae		x				
	Plecoptera			x			
Trichoptera	Agrypnia obsoleta						x
	Allotrichia						x
	Athripsodes		x				x
	Beraeidae	x					
	Cheumatopysche lepida		x				
	Cyrnus trimaculatus	x					
	Diplectrona felix	x	x				
	Ecnomus tenellus		x				
	Economidae	x		x			
	Glossosoma	x	x				
	Glossosoma boltani	x					
	Glossosomatidae		x	x			
	Holocentropus dubius	x	x	x	x		
	Hydropsyche contubernalis	x	x				
	Hydropsyche siltalai	x	x	x	x	x	x
	Hydropsychidae			x			
	Hydroptila	x	x	x	x	x	x
	Lepidostomatidae		x		x	x	x
	Limnephilidae		x	x			x
	Lype phaeopa	x	x			x	

Table 1. (Cont.)

Order		2003	2004	2005	2006	2007	2008
Trichoptera	Metalype fragilis	x	x	x	x		x
	Odontocerum albicorne		x				
	Philopotamidae			x			
	Philopotamus montanus	x	x				
	Phryganea			x			
	Phryganeidae			x			
	Plectrocnemia	x	x				
	Plectrocnemia conspersa				x	x	x
	Polycentropidae		x	x			
	Polycentropus flavomaculatus	x	x	x	x	x	x
	Polycentropus kingi	x	x				x
	Polycentropus irroratus		x				
	Psychomyia pusilla	x	x	x	x	x	x
	Psychomyidae	x	x	x			
	Rhyacophila dorsalis	x	x	x	x	x	x
	Rhyacophila munda		x				
	Rhyacophilidae			x			
	Sericostomatidae		x			x	
	Silo pallipes	x	x	x	x	x	
	Tinodes dives		x				
	Tinodes muculicornis		x				
	Tinodes sp.					x	
	Tinodes waeneri		x		x	x	
	Trichoptera	x	x	x	x	x	x
	Neureclipsis bimaculata						x

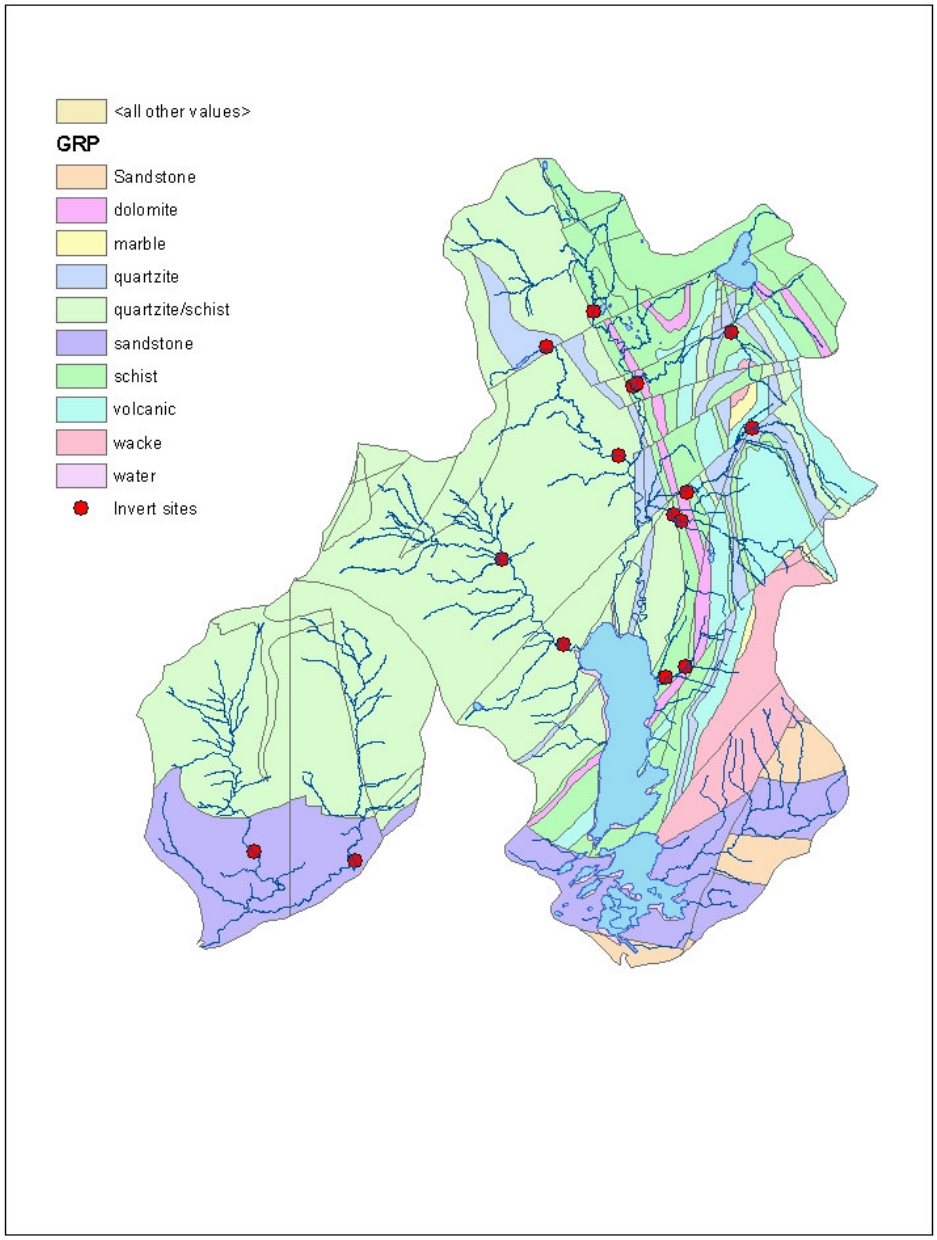

Fig. 1. Geology of the Burrishoole and Owengarve catchments, and position of macroinvertebrate sampling sites.

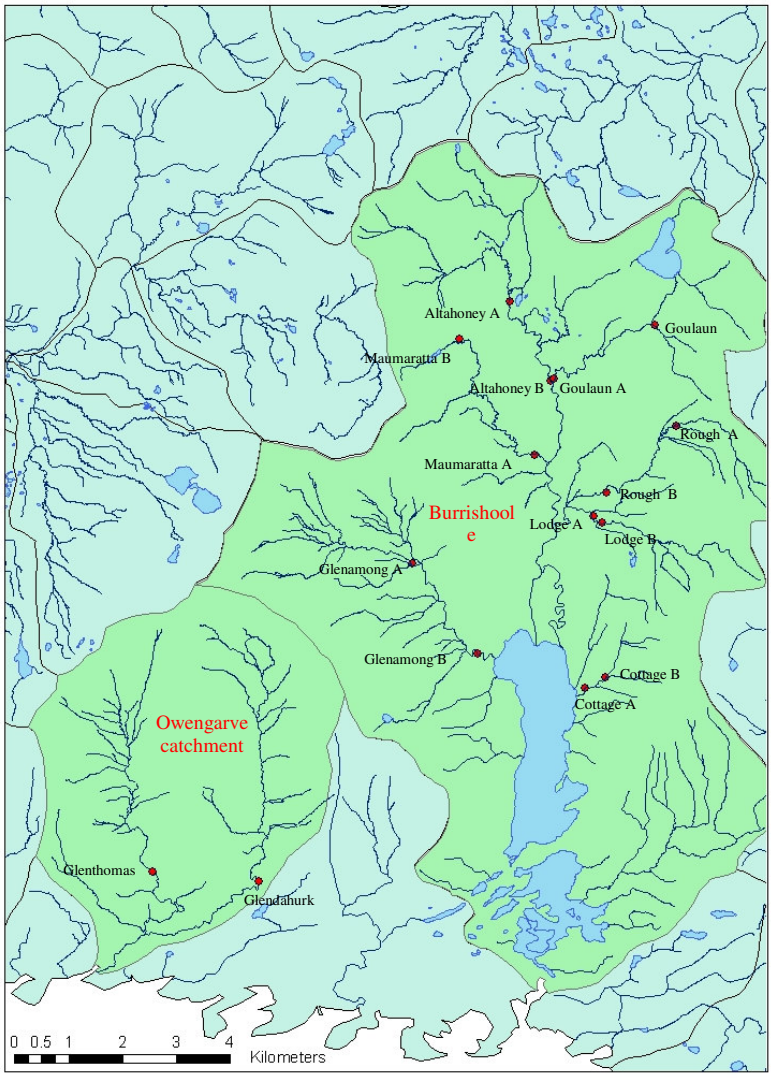

Fig 2. Macroinvertebrate sampling sites in the Burrishoole and Owengarve catchments included in the biological monitoring programs 2003-2007.

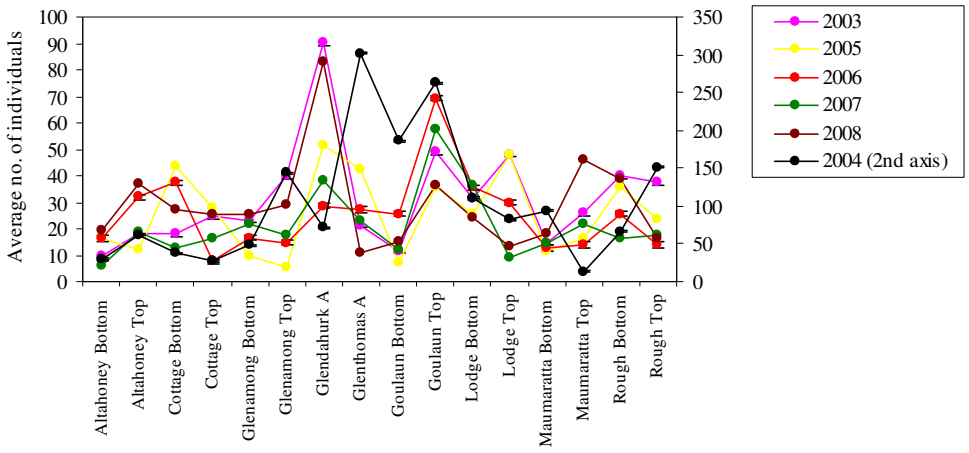

Fig. 3. Average number ± s.d. of macroinvertebrates found in a 1ft sq surber sample in the Burrishoole and Owengarve catchments 2003-2008. N.b. 2004 values are on the secondary axis.

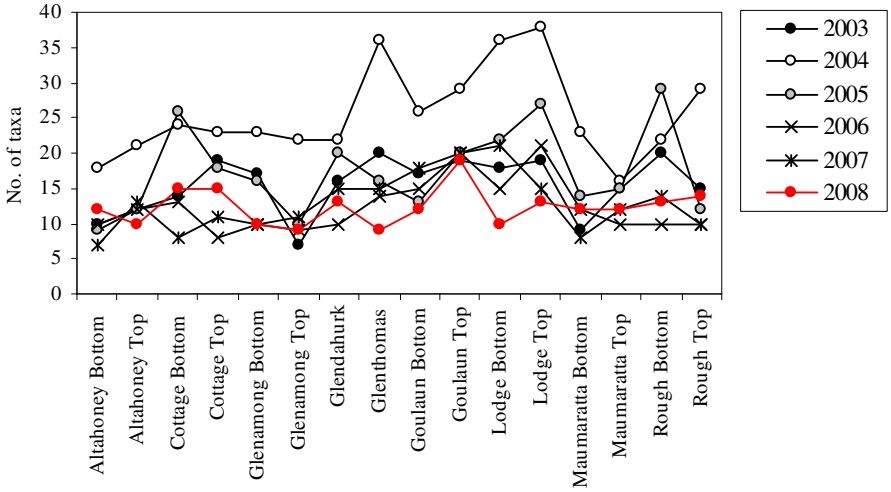

Fig. 4. Number of macroinvertebrate taxa found in 1ft sq surber samples in the Burrishoole and Owengarve catchments 2003-2008.

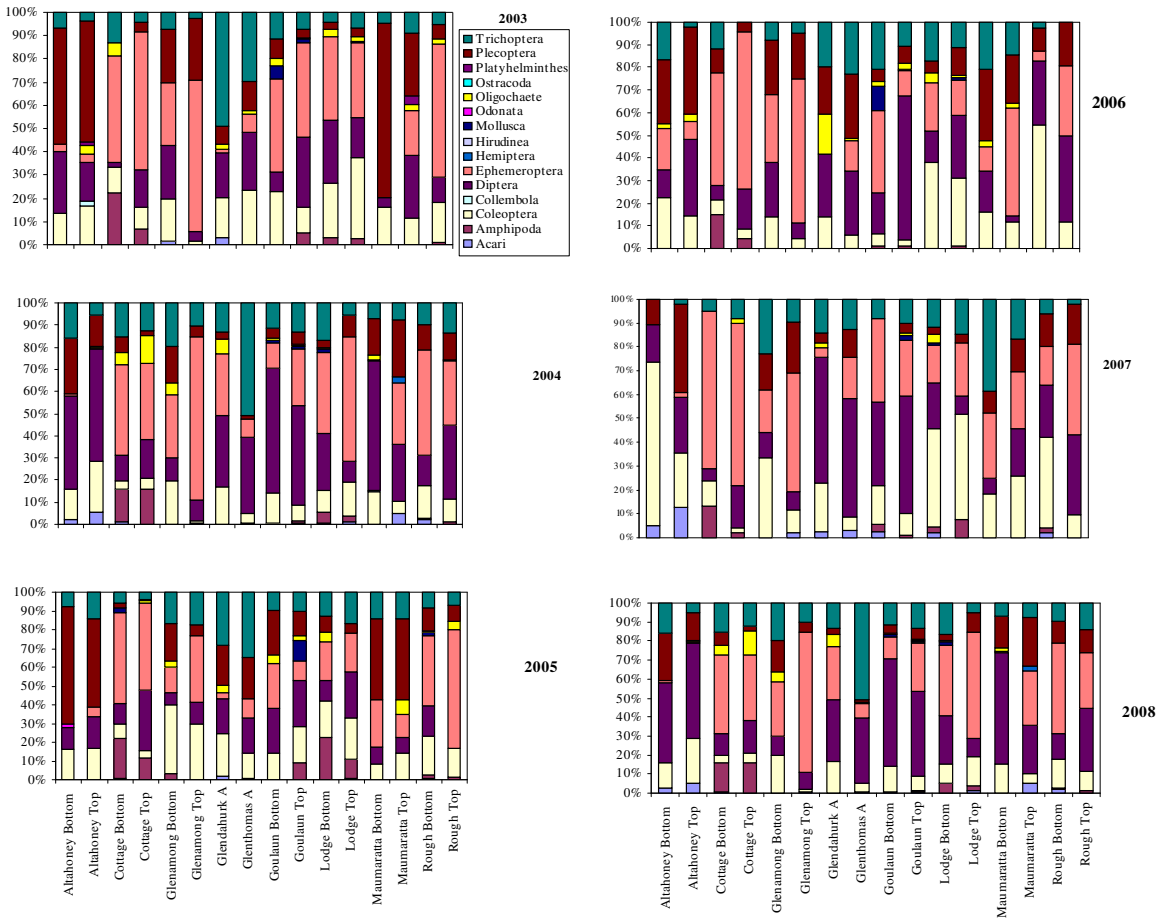

Fig. 5. Proportional abundances of the most common orders of macroinvertebrates found in the Burrishoole and Owengarve catchments, sampled between 2003 and 2008

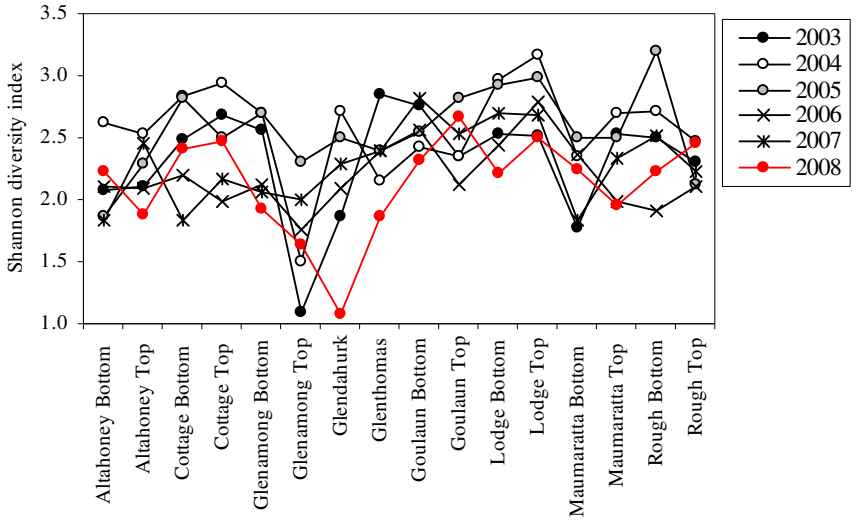

Fig. 6. Shannon diversity index calculated for macroinvertebrates sampled from the Burrishoole and Owengarve catchments 2003-2008.

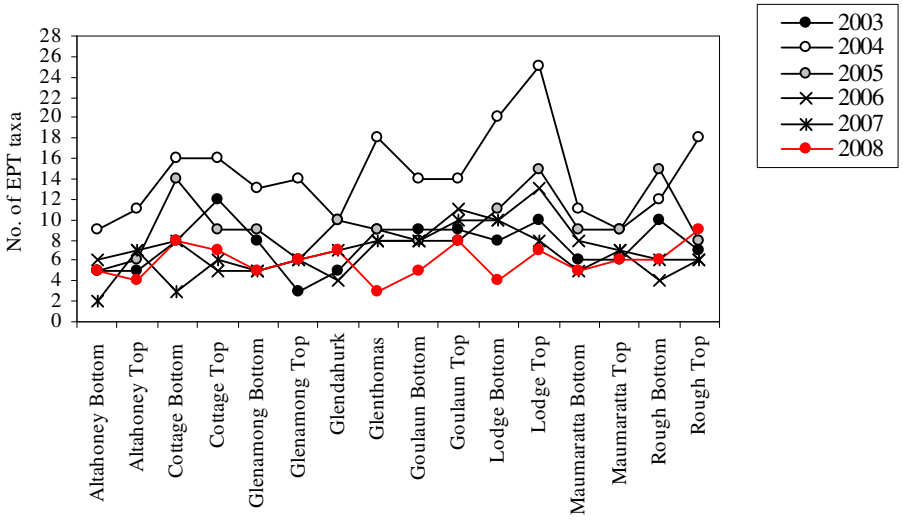

Fig. 7. Number of EPT (Ephemeroptera, Plecoptera, Trichoptera) taxa calculated for macroinvertebrates sampled from the Burrishoole and Owengarve catchments 2003-2008.

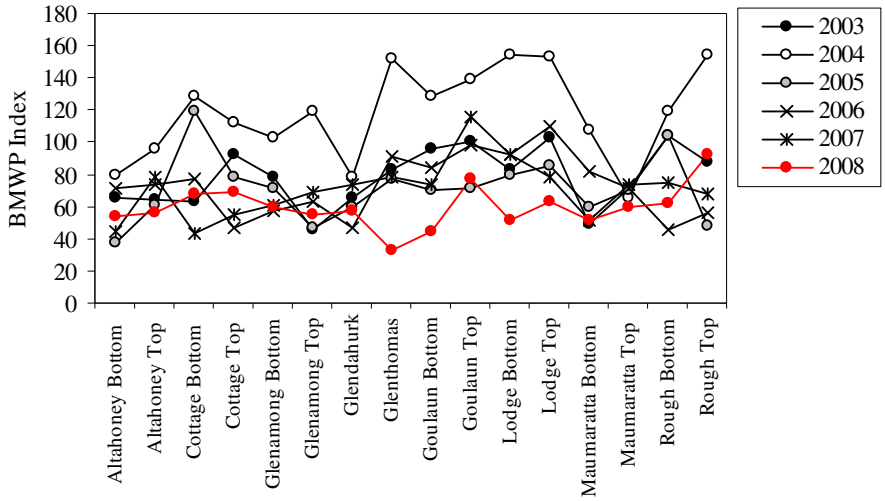

Fig. 8. BMWP calculated for macroinvertebrates sampled from the Burrishoole and Owengarve catchments 2003-2008.

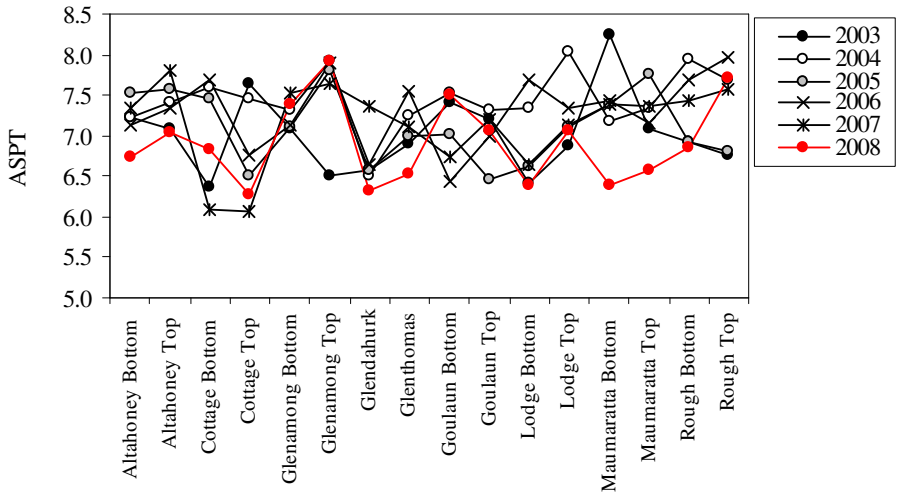

Fig. 9. ASPT calculated for macroinvertebrates sampled from the Burrishoole and Owengarve catchments 2003-2008

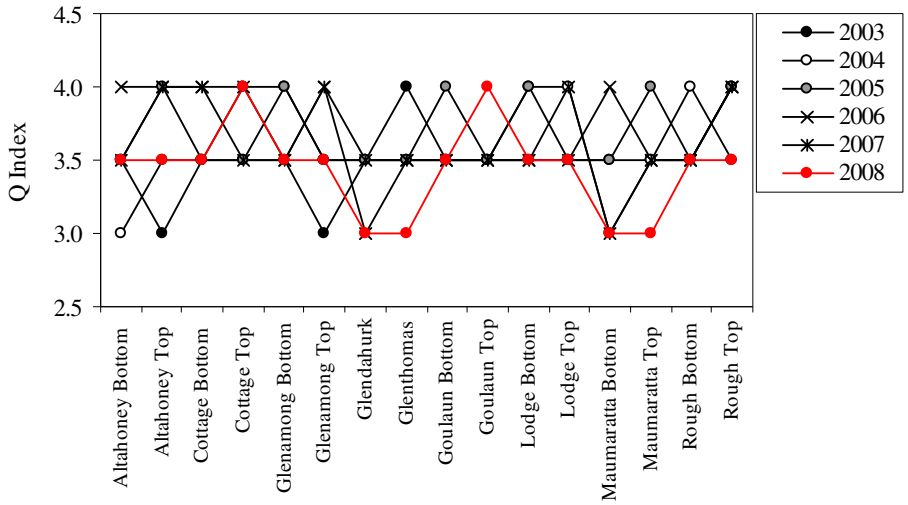

Fig. 10. Q index calculated for macroinvertebrates sampled from the Burrishoole and Owengarve catchments 2003-2005.

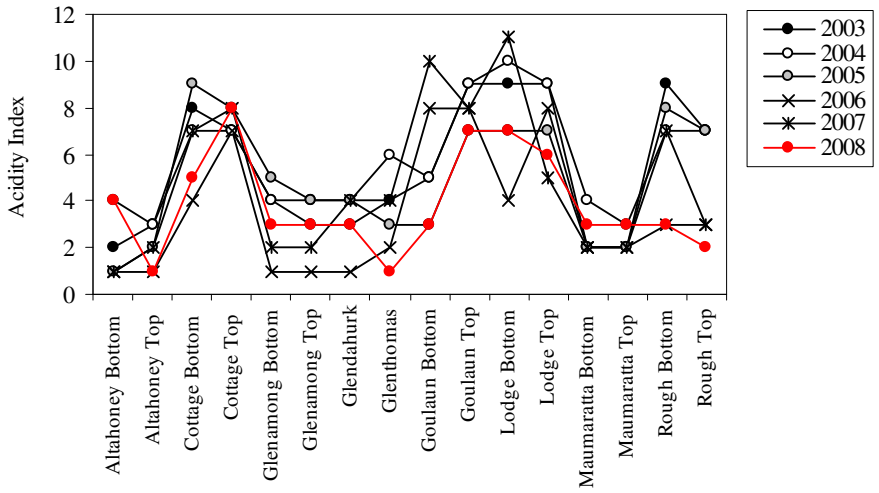

Fig. 11. SI acidity index calculated for macroinvertebrates sampled from the Burrishoole and Owengarve catchments 2003-2005.

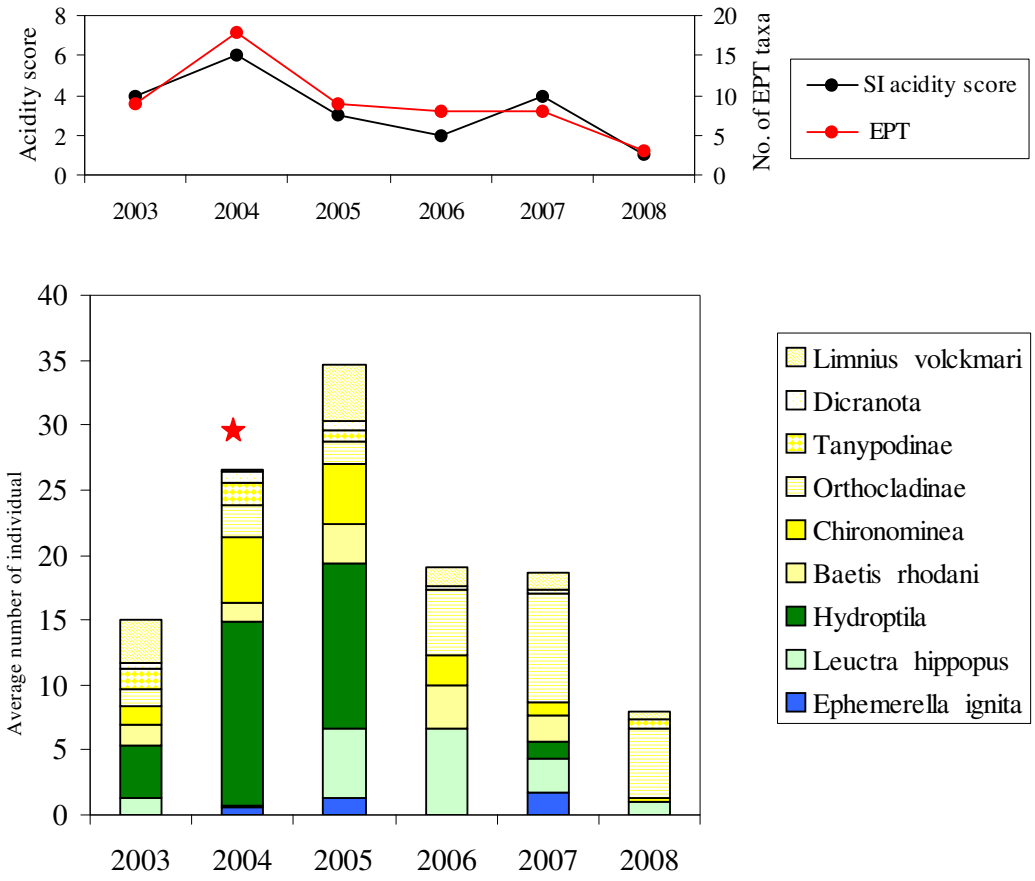

Fig 12. Average abundance of the most common species at the Glenthomas index site 2003-2008 (bottom) and corresponding acidity score and number of EPT taxa (top). The abundance values for 2004 have been divided by ten to allow graphical representation (red asterix).

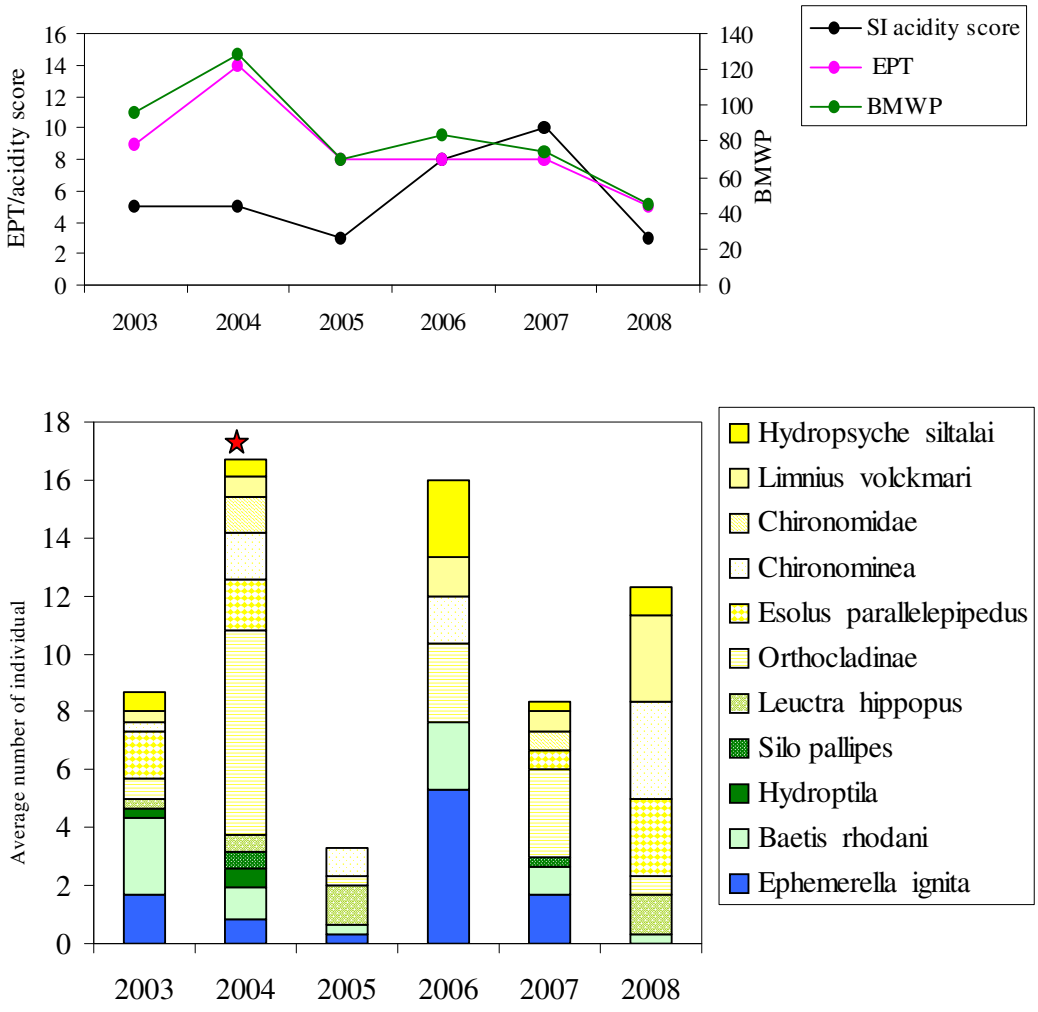

Fig 13. Average abundance of the most common species at the index site at the bottom of the Goulaun river 2003-2008 (bottom) and corresponding acidity score, number of EPT taxa and BMWP index (top). The abundance values for 2004 have been divided by ten to allow graphical representation (red asterix).

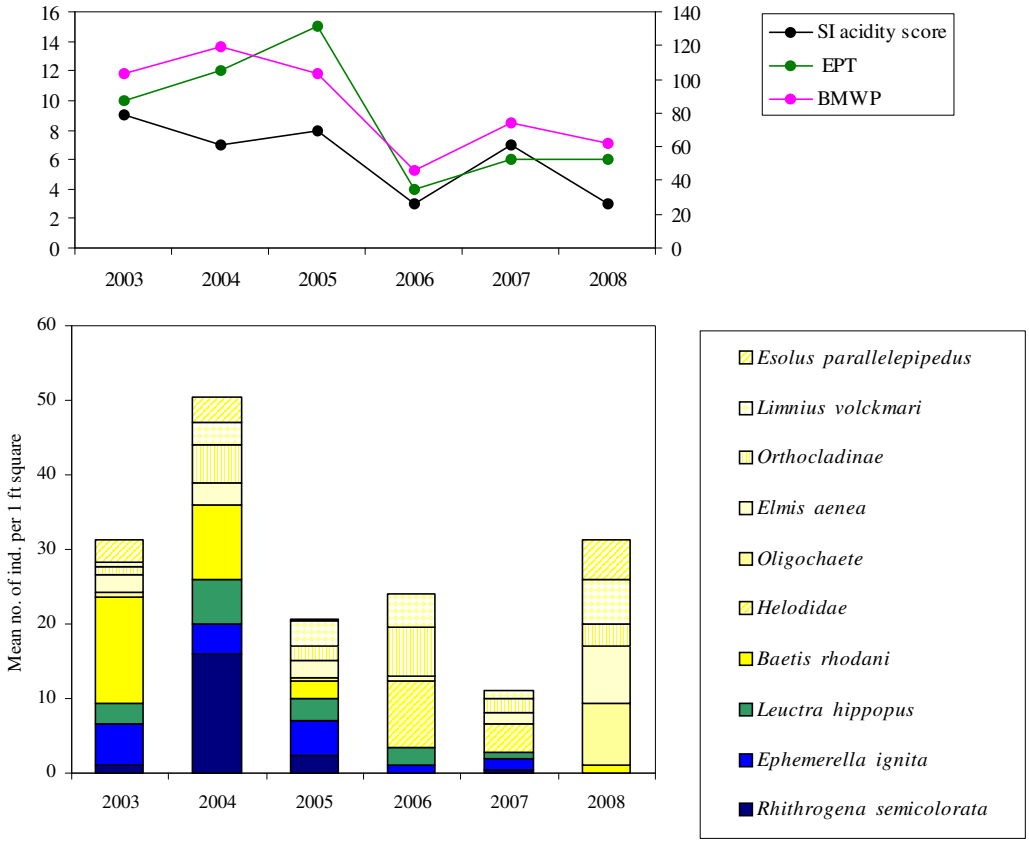

Fig 14. Average abundance of the most common species at the index site at the bottom of the Rough river 2003-2008 (bottom) and corresponding acidity score, number of EPT taxa and BMWP index (top).